TVA

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February 3, 2011

10 CFR 50.4
10 CFR 50.55a

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Browns Ferry Nuclear Plant, Unit 2
Facility Operation License No. DPR-52
NRC Docket No. 50-260

Subject: **Response to NRC Request for Additional Information Regarding American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section XI, Inservice Inspection Program for the Fourth Ten-Year Inspection Interval**

References:

1. NRC Letter to TVA, "Browns Ferry Nuclear Plant, Unit 2 - Request for Additional Information Regarding Relief Request No. 2-ISI-40 Snubbers Inspection and Testing for Fourth 10-Year Interval (TAC No. ME3716)," dated December 15, 2010

2. TVA Letter to NRC, "American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section XI, Inservice Inspection Program for the Fourth Ten-Year Inspection Interval," dated March 31, 2010

On March 31, 2010, the Tennessee Valley Authority (TVA) submitted the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI Inservice Inspection Program for the Fourth Ten-Year Inspection Interval for Browns Ferry Nuclear Plant, Unit 2, which included Relief Request No. 2-ISI-40 (Reference 2). By letter dated December 15, 2010, the NRC transmitted Request for Additional Information (RAI)

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regarding Relief Request No. 2-ISI-40, Snubbers Inspection and Testing for Fourth 10-Year Interval (Reference 1).

Enclosure 1 to this letter provides the TVA responses to the NRC RAI.

Enclosure 2 is TVA's re-submittal of the Relief Request No. 2-ISI-40, Snubbers Inspection and Testing for Fourth 10-Year Interval for Unit 2, which was Attachment 7 of Reference 2. This supersedes the original relief request in Attachment 7.

Enclosure 3 includes copies of References A through L cited in the Relief Request No. 2-ISI-40 noted above. These documents, which were omitted in the original relief request, were originally noted as 'Attachments' to the relief request noted above, and have been re-designated as 'References' for clarity.

Reference K supersedes the original Attachment K.

The due date for this response was specified in the December 15, 2010 NRC letter as 45 days of December 14, 2010, i.e., January 27, 2011. Due to an administrative error, TVA's response to the RAI was not submitted by that date. In a phone conversation between TVA and Chris Gratton (NRC) on January 31, 2011, it was agreed that the revised submittal date of this response would be no later than February 4, 2011.

There are no new regulatory commitments contained in this letter. Please direct any questions concerning this matter to Tom Matthews at (423) 751-2687.

Respectfully,

JC Mattar
for

R. M. Krich

Enclosures:

1. TVA Responses to NRC RAI Questions
2. Relief Request No. 2-ISI-40, Snubbers Inspection and Testing for Fourth 10-Year Interval
3. Relief Request No. 2-ISI-40, References A through L

cc (Enclosures):

NRC Regional Administrator – Region II
NRC Senior Resident Inspector – Browns Ferry Nuclear Plant

ENCLOSURE 1

Tennessee Valley Authority
Browns Ferry Nuclear Plant, Unit 2

Relief Request No. 2-ISI-40, Snubbers Inspection and Testing

TVA Responses to NRC RAI Questions

NRC Question 1

Page 123 of 205, under "BASIS FOR RELIEF," states, in part, that, "The TRM [Technical Requirements Manual], TR 3.7.4 is prepared in accordance with the guidance given by the Nuclear Regulatory Commission in Generic Letter (GL) 90-09, 'Alternative Requirements for Snubber Visual Inspection Intervals and Corrective Actions'." GL 90-09 only provides guidance for snubber visual examination intervals and corrective actions. Please confirm that all others snubber preservice and inservice visual examination and tests requirements of the ASME/American National Standards Institute (ANSI) Code for Operation and Maintenance of Nuclear Power Plants, Part 4 (OM-4), 1987 Edition through the 1988 Addenda, will be met by the proposed alternative.

TVA Response

Reference K documents show the requirements of American Society of Mechanical Engineers (ASME) OM-1987, Part 4, with OMa-1988 requirements will be met by the TRM Program.

NRC Question 2

On page 123 of 205, under "ALTERNATIVE EXAMINATION," the first paragraph states, in part, that, "The BFN Technical Requirements Manual (TRM), TR 3.7.4, requirements will be utilized for the examination and testing of snubbers for preservice, inservice, and repairs/replacement activities." On page 124 of 205, "ALTERNATIVE EXAMINATION," the last paragraph states, in part, that, "In lieu of requirements of IWF-5200(a) and (b), the examination and testing requirements will be met by the TRM Snubber Program." The ASME Code, Section XI, IWF-5200(a) and (b) provide preservice examination and testing requirements of snubbers and IWF-5300(a) and (b) provide inservice examination and testing requirements of snubbers. Please explain how the requirements of IWF-5300(a) and (b) will be met at BFN Unit 2.

TVA Response

"Code Requirements for Which Relief is Requested" has been revised to clarify the sections of ASME Code for which relief is requested. The Browns Ferry Nuclear Plant (BFN), TRM, TR 3.7.4, requirements will be utilized for the inservice examination and testing of snubbers as an alternative to the requirements of IWF-5300(a) and (b).

NRC Question 3

On page 124 of 205, under "JUSTIFICATION FOR THE GRANTING OF RELIEF," the first paragraph states, "The current program, as defined by TR 3.7.4 provides for a level of quality and safety equal to or greater than that provided by the ASME/ANSI OM part 4 ASME Section XI Code 1995 Edition, 1996 Addenda requirements."

a. *Please explain how TR 3.7.4 provides a level of quality and safety equal to or greater than that provided by OM-4, 1987 Edition through the 1988 Addenda.*

b. *Please clarify and provide the basis for the use of ASME Code, Section XI, 1995 Edition, 1996 Addenda requirements, since the code of record for BFN 2 is the ASME Code, Section XI, 2004 Edition (Note: ASME Code Section XI, 2004 Edition, Table IWA-1600-1 requires that the ASME/ANSI OM-4 must be the 1987 Edition through the 1988 Addenda).*

TVA Response

Reference K documents show the requirements of ASME OM-1987, Part 4, with OMa-1988 requirements will be met by the TRM Program. The existing TRM Program for examination and testing of snubbers was promulgated and accepted by NRC when the requirements were included in the BFN, Unit 2, Technical Specifications. These requirements were relocated to the TRM during the conversion of the BFN, Unit 2, Technical Specifications to the Improved Standard Technical Specifications. The scope for snubbers examined and tested in accordance with TR 3.7.4 is not limited by line size or other applicable code exemptions and includes a numerically greater population of snubbers than the Section XI Program. Under the alternate requirements for snubbers, TR 3.7.4 is implemented by Surveillance Instructions 2-SI 4.6.H-1, 0-SI-4.6.H-2A, 0-SI-4.6.H-2B, 0-SI-4.6.H-2C, 0-SI-4.6.H 2E, and 0-SI-4.6.H 2F and Mechanical Preventive Instructions MPI-0-000-SNB002 and MPI-0-000-SNB004. These instructions are written and approved in accordance with the TVA Nuclear Quality Assurance Program and include data sheets for documenting the visual examination and functional test data and results and provide for documentation of non-conforming results and evaluation of those results. The completed data sheets are Quality Assurance (QA) records and are controlled and maintained in accordance with the TVA Nuclear Quality Assurance Program and the BFN QA Records Program. Completed data packages are permanent plant records prepared and stored in accordance with the TVA Nuclear Quality Assurance Program requirements. These records are available onsite for review and inspection.

Based on the information provided above, TVA considers that the alternate BFN, Unit 2, program, in accordance with TR 3.7.4, for the examination and testing of snubbers, provides a level of quality and safety equal to or greater than that provided by OM-4, 1987 Edition through the 1988 Addenda.

NRC Question 4

On page 125 of 205, the sixth paragraph states, in part, that, "Personnel performing the TRM required visual examinations are 'process qualified' to perform the examinations and testing as required by the TRM and implemented by referenced procedures." IWF-5200(a) and IWF-5300(a) requires that preservice and inservice examination shall be performed using the VT-3 visual examination method as described in IWA-2213. Please explain how "process qualified" personnel training is equivalent to the required VT-3 visual examination method as described in IWA-2213.

TVA Response

IWA-2317 provides alternative qualifications of VT-3 visual examination personnel. These alternative requirements require 1) at least 40 hours plant experience, such as that gained by plant personnel involved in installation, maintenance, or examination of pumps, valves, and supports, quality control personnel, and nondestructive examination personnel, 2) at least 8 hours of training in Section XI requirements and plant specific procedures for VT-3 visual examination, and 3) the vision test requirements of IWA-2321.

Personnel performing the TRM required visual examinations are qualified in accordance with the Maintenance Training Program. The qualification to perform visual examination of snubbers in accordance with the TRM Program requires Task Qualification MMY-501. This task qualification requires Snubber Visual Examination Training (MTM150.000), documented on-the-job-training, and satisfactory visual acuity examination as prerequisites to the qualification for Perform Visual Examination of Mechanical and Hydraulic Snubbers (MMY-501).

Maintenance personnel selected to perform visual examinations of snubbers in accordance with the TRM Snubber Program are required to have sufficient plant experience and visual acuity to meet the requirements of IWA-2317. Maintenance personnel performing snubber visual examinations under the current TRM Snubber Program on BFN, Units 1, 2, and 3 have not received at least 8 hours of training in the Section XI requirements and plant specific procedures for VT-3 visual examination since these personnel are not required to perform ASME visual examinations under the existing programs for each BFN unit.

With the exception of the minimum 8 hours of training in the Section XI requirements and plant specific procedures for VT-3 visual examination, personnel performing visual examination in accordance with the TRM Program meet the requirements for VT-3 examination. The training required to become qualified to visually inspect snubbers includes demonstrated proficiency in performance of program procedures; therefore, TVA considers that the qualification of personnel performing the visual examinations under the alternate BFN, Unit 2, program, in accordance with TR 3.7.4, for the examination and testing of snubbers, will provide an acceptable level of quality and safety.

NRC Question 5

Pages 127 and 128 of 205, list Attachments A through K for this submittal, but only Attachment K is included in the submittal. Please explain why Attachments A through J are not included in the submittal.

TVA Response

Attachments A through J referred to stand-alone Snubber Program procedures associated with Request for Relief No. 2-ISI-40. The stand-alone attachments should have been included in the submittal and are now provided in this response. These documents have been re-designated as 'References' to avoid confusion with the various attachments of the complete BFN, Unit 2, Relief Request No. 2-ISI-40, Snubbers Inspection and Testing for Fourth Ten-Year Interval.

Reference K has been revised to supersede the Attachment K that was submitted by TVA. This revision included a reference to another procedure, which has been included as Reference L.

References A through L are included in this response as Enclosure 3.

NRC Question 6

The proposed alternative does not address the requirements of OM-4, Section 2.3.4.3, "Examination Failure Mode Groups," and Section 3.2.4.2, "Test Failure Mode Groups," related to inservice examination and functional testing of snubbers. Please explain how the proposed alternative meets these requirements.

TVA Response

OM Part 4, Section 2.3.4.3, Examination Failure Mode Groups: Unacceptable snubbers shall be categorized into examination failure mode groups. An examination failure mode group shall include all unacceptable snubbers which have a given failure and all other snubbers subject to the same failure, except as permitted to be considered separately under paragraph 1.6. The examination failure mode groups shall be distinct for examination purposes from any testing failure mode groups. The following examination failure mode groups shall be used:

a. Design/manufacturing

b. Application induced

c. Maintenance/repair/installation

d. Isolated

e. Unexplained

The BFN Snubber Program does not categorize examination failures into failure mode groups. The TRM Program ensures the cause of all examination failures is established and remedied for that particular snubber and for other snubbers that may be generically susceptible. The snubber failure classifications and definitions are similar to those required by OM Code. In accordance with 0-TI-398, Snubber Program Procedure, snubber failures are classified as follows:

> <u>Location</u> - A failure of a snubber(s) resulting from environmental conditions. Examples include failure of a snubber due to excessive heat, failure due to excessive local system vibration, or failure due to other localized anomalies.
>
> <u>Manufacturing</u> - A failure resulting from a potential defect in manufacturing. Examples include incorrectly assembled snubbers, inclusion of incorrect piece parts, and failure of a snubber(s) due to improper or incorrect maintenance or repair practices performed by the vendor.
>
> <u>Design</u> - A failure resulting from an error in the design. This classification would include incorrectly sized snubbers, snubbers provided with insufficient travel, snubbers with insufficient swing margins, and design misapplications or errors.
>
> <u>Unknown</u> - A failure that cannot be categorized as location, manufacturing, design, or other. This includes all failures for which the cause of failure cannot be determined.
>
> <u>Other</u> - When the unknown cause of the failure cannot be categorized as location, manufacturing, or design. This classification would include snubbers that fail due to end of service life. Additional examples include failure of snubbers due to plant transients, misapplication of rigging loads to the snubber, and incidental interaction of tools or equipment on the snubber.

OM Part 4, Section 3.2.4.2, Test Failure Mode Groups. Unacceptable snubber(s) shall be categorized into test failure mode group(s). A test failure mode group(s) shall include all unacceptable snubbers that have a given failure mode, and all other snubbers subject to the same failure mode. The following failure modes shall be used:

a. Design/manufacturing

b. Application induced

c. Maintenance/repair/installation

d. Isolated

e. Unexplained

The TRM Snubber Program ensures the cause of all examination failures is established and remedied for that particular snubber and for other snubbers that may be generically susceptible. The snubber failure classifications and definitions are similar to those required by OM Code. For BFN Unit 2, TSR 3.7.4.4, Note states: This testing is independent of the requirements of TSR 3.7.4.3. For any snubber which fails to lockup or fails to move (i.e., frozen in place), evaluate the cause. If caused by manufacturer or design deficiency, perform in place or bench functional test of all snubbers of the same design, subject to the same defect. The functional test acceptance criteria shall be as specified in TSR 3.7.4.2.

In addition, the applicable Surveillance Instructions require an engineering evaluation of the snubber failure, and classification of the snubber failure mode as isolated, location, manufacturing, design, or other. The engineering evaluation includes determination of subsequent testing required, based on the failure mode, which may involve testing of snubbers susceptible to the same failure mode. However, establishment of specific groupings based on failure modes is not performed.

Technical Instruction, 0-TI-398, provides the following scope expansion and additional testing requirements due to the failure mode:

If the failure was found as part of the TRM initial or any subsequent samples, the following is the minimum required testing expansion:

a. Expand the sample by 10 percent of the remaining snubbers in the subgroup, and

b. If the cause of the failure is determined to be a system transient, test all snubbers on that system, which could have been affected by the transient, and

c. If the cause is a generic manufacturing defect, test all snubbers of that same type, and

d. Identify and test all other snubbers suspected of the same failure mode.

If the failure was found outside of the TRM initial or any subsequent samples (i.e., other maintenance activity, testing directed/requested by the Snubber Engineer, Service Life Monitoring testing, testing of snubbers on non-Technical Specifications or TRM systems, etc.) the following is the minimum required testing expansion:

a. If the cause of failure is determined to be a system transient, test all snubbers on that system, which could have been affected by the transient, and

b. If the cause is a generic manufacturing defect, test all snubbers of that same type, and

c. Identify and test all other snubbers suspected of the same failure mode.

Both the OM Code and the TRM alternative require evaluation and additional examinations or tests to be performed to ensure other snubbers subject to the same failure are addressed. The differences between the "Examination Failure Mode Groups" and "Test Failure Mode Groups" related to inservice examination and functional testing of snubbers of the OM Code and the TRM alternative are differences in methodologies that seek to achieve the same result. A level of quality and safety equal to or greater than that provided by OM-4, 1987 Edition through the 1988 Addenda is provided by the TRM alternative.

NRC Question 7

The applicable code for the BFN Unit 2 ISI program is the ASME Code, Section XI, 2004 Edition. The ASME Code, Section XI, 2004 Edition, Paragraph IWA-6230, "Summary Report Preparation," requires an inservice inspections summary report to be prepared at the completion of the inservice inspection conducted during a refueling outage. Please explain how the proposed alternative meets this requirement.

TVA Response

TVA seeks relief from IWA-6230, Summary Reports (for snubbers), and IWA-6240 for the submittal of these reports. Because relief is sought from the ASME Section XI snubber examination and test requirements, there will be no ASME Section XI snubber examination and test activities to document in a summary report. TRM Program procedures are written and approved in accordance with the TVA Nuclear Quality Assurance Program and include data sheets for documenting the visual examination and functional test data and results, and provide for documentation of non-conforming results and evaluation of those results. The completed data sheets are Quality Assurance records and are controlled and maintained in accordance with the TVA Nuclear Quality Assurance Program and the BFN QA Records Program. Completed data packages are permanent plant records prepared and stored in accordance with the TVA Nuclear Quality Assurance Program requirements. These records are available onsite for review and inspection.

ENCLOSURE 2

Tennessee Valley Authority
Browns Ferry Nuclear Plant, Unit 2

Relief Request No. 2-ISI-40, Snubbers Inspection and Testing

Relief Request No. 2-ISI-40, Snubbers Inspection and Testing for Fourth 10-Year Interval

Executive Summary

Pursuant to 10 CFR 50.55a(a)(3)(i), TVA is requesting relief to use an alternative from the American Society of Mechanical Engineers (ASME) Section XI Code requirements related to selection, examination, and testing of snubbers. TVA proposes to use the selection, examination, and testing plans currently defined in the Browns Ferry Nuclear Plant (BFN) Technical Requirements Manual (TRM) (TR 3.7.4). The TRM criteria have been promulgated and approved by the NRC, while ASME Section XI imposes overlapping requirements, which do not enhance the quality or safety of the snubber examination and testing program.

Components: Component/piping snubbers

Code Class: 1, 2, 3, and MC

Examination Category: N/A

Item Number: N/A

Code Requirements: 2004 Edition of ASME Section XI

IWF-5200(a) and (b) preservice examination and testing in accordance with the first Addenda to ASME/ANSI OM-1987, Part 4, with OMa-1988.

IWF-5300(a) and (b) inservice examination and testing in accordance with the first Addenda to ASME/ANSI OM-1987, Part 4, with OMa-1988.

IWF-5400 Repairs and Replacements of snubbers shall be in accordance with the first Addenda to ASME/ANSI OM-1987, Part 4, with OMa-1988.

IWA-6230 and IWA-6240 require inservice inspection summary reports for snubbers and submittal of these reports to the regulatory authority.

IWA-2110 requires Authorized Nuclear Inservice Inspector (ANII) involvement for snubber examination and testing.

Code Requirements from Which Relief is Requested

In accordance with 10 CFR 50.55a(a)(3)(i), relief is requested from the ASME Section XI 2004 Edition requirement for inservice examinations and tests for snubbers, and repair/replacement examinations and tests of snubbers:

> IWF-5200(a) and (b) Preservice Examinations and Tests, and implied OM-1987, Part 4, with OMa-1988, Sections 2.1, Preservice Examination, 2.2, Preservice Thermal Movement Examination, 2.4, Examination Documentation, and 3.1, Preservice Operability Testing, and 3.3, Testing Documentation.
>
> IWF-5300(a) and (b) Inservice Examinations and Tests, and implied OM-1987, Part 4, with OMa-1988, Sections 2.3, Inservice Examination, 2.4, Examination Documentation, and 3.2, Inservice Operability Testing, and 3.3, Testing Documentation.
>
> IWF-5400 Repairs and Replacements of snubbers shall be in accordance with ASME/ANSI OM-1987, Part 4, with OMa-1988, Sections 1.5.6, Snubber Maintenance or Repair, and 1.5.7, Snubber Modification and Replacement.
>
> IWA-6230 and IWA-6240, Inservice Inspection Summary Reports (for snubbers) and submittal of these reports to the regulatory authority.
>
> IWA-2110, Duties of the Inspector (for involvement for snubber examination).

Basis for Relief

ASME Section XI Class 1, 2, and 3 equivalent snubbers are examined and tested in accordance with BFN, Unit 2, TRM, TR 3.7.4, "Snubbers." The TRM is prepared in accordance with the guidance given by NRC in Generic Letter 90-09, "Alternative Requirements for Snubber Visual Inspection Intervals and Corrective Actions." The scope for snubbers examined and tested in accordance with TR 3.7.4 is not limited by line size or other applicable code exemptions and includes a numerically greater population of snubbers than the Section XI Program. Examination and testing of the snubbers in accordance with both ASME Section XI and the BFN, Unit 2, TRM would result in a duplication of effort utilizing different standards and require the preparation of a separate program and associated procedures. This would result in additional cost and unnecessary radiological exposure. In addition, the personnel performing snubber visual examinations would also be required to be certified in accordance with the American Society of Nondestructive Testing (ASNT) ASNT-TC-1A "Personnel Qualification and Certification in Nondestructive Testing," and ASME/ASNT-CP-189. This is an additional certification as compared to the task training qualification required to perform the TRM required examinations and testing of snubbers. The existing TRM Program for examination and testing of snubbers was promulgated and accepted by NRC when the requirements were included in the BFN, Unit 2, Technical Specifications. These requirements were relocated to the TRM during the conversion of the BFN, Unit 2, Technical Specifications to the Improved Standard Technical Specifications.

The implementation of OM-1987, Part 4, with OMa-1988 would require BFN to initiate a snubber examination and testing program that is more complicated and expensive to perform without a compensating increase in the level of quality and safety.

Alternate Examinations

The BFN TRM, TR 3.7.4, requirements will be utilized for the examination and testing of snubbers for preservice, inservice, and repair/replacement activities in lieu of the requirements of IWF-5200(a) and (b) and IWF-5300(a) and (b). The procedures utilized for these examinations are:

> Surveillance Instruction, 2-SI-4.6.H-1,"Visual Examination of Hydraulic and Mechanical Snubbers"
>
> Surveillance Instruction, 0-SI-4.6.H-2A, "Functional Testing of Mechanical Snubbers"
>
> Surveillance Instruction, 0-SI-4.6.H-2B, "Functional Testing of Bergen-Paterson, Anchor/Darling or Fronek Hydraulic Snubbers"
>
> Surveillance Instruction, 0-SI-4.6.H-2C, "Functional Testing of Bergen-Paterson Torus Dynamic Restraints"
>
> Surveillance Instruction, 0-SI-4.6.H-2E, "Functional Testing of Lisega Large Bore Torus Dynamic Restraint Snubbers"
>
> Surveillance Instruction, 0-SI-4.6.H-2F, "Functional Testing of Lisega Type 30 Hydraulic Snubbers"
>
> Mechanical Preventive Instruction, MPI-0-000-SNB002, "Hydraulic Shock and Sway Arrestor Bergen-Patterson Anchor/Darling and Fronek Unit Disassembly and Reassembly"
>
> Mechanical Preventive Instruction, MPI-0-000-SNB004, "Removal and Reinstallation of Snubbers"
>
> Technical Instruction, 0-TI-398, "Snubber Program Procedure"

This will include the pin-to-pin area inclusive of applicable snubbers.

Testing of repaired and replaced snubbers will also be performed in accordance with TR 3.7.4.

Visual examination of repaired and replaced snubbers will be performed in accordance with Mechanical Preventive Instruction, MPI-0-000-SNB004, "Removal and Reinstallation of Snubbers."

Snubber examination and testing data will be maintained in accordance with the requirements of TR 3.7.4, the BFN Corrective Action Program, NPG-SPP-03.1, "Corrective Action Program," and the implementing procedures (2-SI-4.6.H-1, 0-SI-4.6.H-2A, 0-SI-4.6.H-2B, 0-SI-4.6.H-2C, 0-SI-4.6.H-2E, 0-SI-4.6.H-2F, 0-TI-398, MPI-0-000-SNB002, and MPI-0-000-SNB004).

The areas inclusive of the pins back to building structure and to the component/piping being supported will remain in the ASME Section XI examination boundary (Inservice Inspection (ISI) Program); therefore, IWF-5200(c) and IWF 5300(c) will be met by the Section XI Program.

The provisions of IWA-4000 will be met for the repair/replacement activities on snubbers by the current Repair and Replacement Program. TVA seeks relief from the examination and testing requirements of IWF-5200 required by IWF-5400 which requires snubbers installed, corrected, or modified by repair/replacement activities to be examined and tested in accordance with ASME/ANSI OM, Part 4. The examination and testing of snubbers will be in accordance with the TRM Snubber Program in lieu of requirements of IWF-5200(a) and (b).

Justification for the Granting of Relief

The current program, as defined by TR 3.7.4, provides for an acceptable level of quality and safety that is equal to or greater than that provided by ASME/ANSI OM-1987, Part 4, with OMa-1988 requirements.

Examination, testing, repair, and replacement of snubbers is currently performed in accordance with TR 3.7.4, which utilizes the guidance provided by NRC in Generic Letter 90-09. The OM Code referenced by ASME Section XI 2004 Edition has a different basis for examination and testing plans. It is impractical to implement both plans because of the resulting duplication of examination and testing efforts and different requirements for snubber quantities subject to examination or test, actually examined and/or tested, and sample expansion requirements. This would result in additional cost and unnecessary radiological exposure. The existing TRM Program for examination and testing of snubbers has been promulgated and accepted by NRC. The differences in the two programs could create confusion when selecting test samples, applying acceptance criteria, corrective actions, and examination schedules for failed snubbers. This situation could increase the possibility of applying the wrong action, thus creating a nonconformance, an inoperability, or even a violation of a TRM requirement.

To eliminate any misinterpretation or confusion in administering overlapping requirements for snubbers and to remove the possibility of applying contradicting requirements to the same snubber(s), BFN proposes to examine and test BFN, Unit 2, snubbers in accordance with BFN, Unit 2, TR 3.7.4.

Subarticle IWF-5400 of the 2004 Edition of the Code provides the requirements for repair and replacement of snubbers to be in accordance with IWA-4000. IWF-5200 requires that examinations shall be performed in accordance with ASME/ANSI OM, Part 4. This requirement is implemented in TR 3.7.4.6. This program requires replacement snubbers and snubbers that have repairs which might affect the functional test results, to be tested to meet the functional test criteria prior to installation.

Mechanical Preventive Instruction, MPI-0-000-SNB004, provides visual examination criteria for installation of a snubber after repair or replacement. The ASME Section XI repair/replacement program at BFN documents the verification of acceptability for repairs and replacements per IWA-4160.

Technical Instruction, 0-TI-398, states that personnel performing the visual inspections of 2-SI-4.6.H-1 must meet the visual acuity requirements of ASME Section XI, 2001 Edition, 2003 Addenda, paragraph IWA-2321.

ASME Section XI VT-3 certification required by personnel performing snubber visual examinations is an additional certification as compared with the TRM Program training qualifications. Personnel performing the TRM required visual examinations are "process qualified" to perform the examinations and testing as required by the TRM and implemented by the referenced procedures. This training currently includes visual acuity and specific training on the requirements and acceptance criteria associated with Surveillance Instruction, 2-SI-4.6.H-1. The training and documentation of BFN personnel responsible for snubber visual examination and testing specified in the TRM implementing procedures provides an acceptable level of quality and safety.

Because relief is sought from the ASME Section XI snubber examination and test requirements, there will be no ASME Section XI snubber examination and test activities to require ANII involvement. The BFN TRM Snubber Program does not require the use of an ANII for examination and test requirements. The ANII will not be involved in the TRM required visual examination or testing activities performed in lieu of the ASME Code requirements. A BFN Snubber Program engineer provides the oversight of the TRM Snubber Program implementation for both the visual examination and functional testing. This oversight includes both review and evaluation of visual examination and functional testing data to ensure TRM requirements are met. The BFN Snubber Program engineer provides the oversight that ensures an acceptable level of quality and safety exist without ANII involvement in these activities. ANII involvement will be maintained in inservice repair and replacement snubber activities, as required by IWA-2110(g) and (h) and implemented by the BFN ASME Section XI repair and replacement program.

ASME Section XI, 2004 Edition Subarticle IWA-6230 provides requirements for ISI and inservice testing (IST) documentation for snubbers in the framework of a summary report. Under the alternate requirements for snubbers, there will be no ASME Section XI ISI and IST documentation to include in a summary report. TR 3.7.4 is implemented by Surveillance Instructions 2-SI-4.6.H-1, 0-SI-4.6.H-2A, 0-SI-4.6.H-2B, 0-SI-4.6.H-2C, 0-SI-4.6.H-2E, and 0-SI-4.6.H-2F and Mechanical Preventive Instructions MPI-0-000-SNB002 and MPI-0-000-SNB004. These instructions are written and approved in accordance with the TVA Nuclear Quality Assurance Program and include data sheets for documenting the visual examination and functional test data and results, and provide for documentation of non-conforming results and evaluation of those results. The completed data sheets are Quality Assurance (QA) records and are controlled and maintained in accordance with the TVA Nuclear Quality Assurance Program and the BFN QA Records Program. Completed data packages from Surveillance Instructions 2-SI-4.6.H-1, 0-SI-4.6.H-2A, 0-SI-4.6.H-2B, 0-SI-4.6.H-2C, 0-SI-4.6.H-2E, and 0-SI-4.6.H-2F are permanent plant records prepared and stored in accordance with the TVA Nuclear Quality Assurance Program requirements. These records are available onsite for review and inspection. The QA records documenting snubber visual examinations and functional tests provide an acceptable level of quality and safety when compared to the requirements of ASME Section XI and OM 1987, Part 4.

The alternate ISI and IST Program, including the generated QA records documenting snubber ISI and IST, provides an acceptable level of quality and safety when compared to the requirements of ASME Section XI, 2004 Edition.

Based on the justification provided, TVA's examination and testing of BFN snubbers, in accordance with TR 3.7.4, will provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), TVA requests that relief be granted from the ASME Section XI, 2004 Edition requirements related to ISI and IST of snubbers.

TVA's relief is consistent with Relief Request No. 1-ISI-18 submitted by TVA letters dated May 27, 2008 and October 22, 2008, for the BFN, Unit 1, Second Ten-Year Inservice Inspection Interval. The NRC staff approved the request for relief by letter dated April 2, 2009.

Reference K contains a comparison of the OM Part 4 requirements and the BFN TRM alternatives.

Based on the information provided above, TVA considers that the alternate BFN, Unit 2, program, in accordance with TR 3.7.4, for the examination and testing of snubbers, will provide an acceptable level of quality and safety.

Implementation Schedule

This request for relief is applicable to the Fourth Ten-Year Inservice Inspection Interval for BFN, Unit 2 (May 25, 2011 through May 24, 2021).

References

Reference A	BFN-Unit 2, Technical Requirements Manual, TR 3.7.4, "Snubbers"
Reference B	Browns Ferry Nuclear Plant, Technical Instruction, 0-TI-398, "Snubber Program Procedure"
Reference C	Browns Ferry Nuclear Plant, Surveillance Instruction, 2-SI-4.6.H-1, "Visual Examination of Hydraulic and Mechanical Snubbers"
Reference D	Browns Ferry Nuclear Plant, Mechanical Preventive Instruction, MPI-0-000-SNB004, "Removal and Reinstallation of Snubbers"
Reference E	Browns Ferry Nuclear Plant, Surveillance Instruction, 0-SI-4.6.H-2A, "Functional Testing of Mechanical Snubbers"
Reference F	Browns Ferry Nuclear Plant, Surveillance Instruction, 0-SI-4.6.H-2B, "Functional Testing of Bergen-Paterson, Anchor/Darling or Fronek Hydraulic Snubbers"
Reference G	Browns Ferry Nuclear Plant, Surveillance Instruction, 0-SI-4.6.H-2C, "Functional Testing of Bergen-Paterson Torus Dynamic Restraints"
Reference H	Browns Ferry Nuclear Plant, Surveillance Instruction, 0-SI-4.6.H-2E, "Functional Testing of Lisega Large Bore Torus Dynamic Restraint Snubbers"
Reference I	Browns Ferry Nuclear Plant, Surveillance Instruction, 0-SI-4.6.H-2F, "Functional Testing of Lisega Type 30 Hydraulic Snubbers"

Reference J	Browns Ferry Nuclear Plant, Modification And Additions Instruction, MAI-4.10, "Piping Clearance Instruction"
Reference K	Comparison of TRM Program to ASME OM, Part 4
Reference L	Browns Ferry Nuclear Plant, Mechanical Preventive Instruction, MPI-0-000-SNB002, "Hydraulic Shock and Sway Arrestor Bergen-Patterson Anchor/Darling and Fronek Unit Disassembly and Reassembly"

ENCLOSURE 3

Tennessee Valley Authority
Browns Ferry Nuclear Plant, Unit 2

Relief Request No. 2-ISI-40, Snubbers Inspection and Testing

Relief Request No. 2-ISI-40, References A through L

Reference A	BFN-Unit 2, Technical Requirements Manual, TR 3.7.4, "Snubbers"
Reference B	Browns Ferry Nuclear Plant, Technical Instruction, 0-TI-398, "Snubber Program Procedure"
Reference C	Browns Ferry Nuclear Plant, Surveillance Instruction, 2-SI-4.6.H-1, "Visual Examination of Hydraulic and Mechanical Snubbers"
Reference D	Browns Ferry Nuclear Plant, Mechanical Preventive Instruction, MPI-0-000-SNB004, "Removal and Reinstallation of Snubbers"
Reference E	Browns Ferry Nuclear Plant, Surveillance Instruction, 0-SI-4.6.H-2A, "Functional Testing of Mechanical Snubbers"
Reference F	Browns Ferry Nuclear Plant, Surveillance Instruction, 0-SI-4.6.H-2B, "Functional Testing of Bergen-Paterson, Anchor/Darling or Fronek Hydraulic Snubbers"
Reference G	Browns Ferry Nuclear Plant, Surveillance Instruction, 0-SI-4.6.H-2C, "Functional Testing of Bergen-Paterson Torus Dynamic Restraints"
Reference H	Browns Ferry Nuclear Plant, Surveillance Instruction, 0-SI-4.6.H-2E, "Functional Testing of Lisega Large Bore Torus Dynamic Restraint Snubbers"
Reference I	Browns Ferry Nuclear Plant, Surveillance Instruction, 0-SI-4.6.H-2F, "Functional Testing of Lisega Type 30 Hydraulic Snubbers"
Reference J	Browns Ferry Nuclear Plant, Modification And Additions Instruction, MAI-4.10, "Piping Clearance Instruction"
Reference K	Comparison of TRM Program to ASME OM, Part 4
Reference L	Browns Ferry Nuclear Plant, Mechanical Preventive Instruction, MPI-0-000-SNB002, "Hydraulic Shock and Sway Arrestor Bergen-Patterson Anchor/Darling and Fronek Unit Disassembly and Reassembly"

Tennessee Valley Authority
Browns Ferry Nuclear Plant, Unit 2

Relief Request No. 2-ISI-40, Snubbers Inspection and Testing

Relief Request No. 2-ISI-40, Reference A

BFN-Unit 2, Technical Requirements Manual, TR 3.7.4, “Snubbers”

TR 3.7 PLANT SYSTEMS

TR 3.7.4 Snubbers

LCO 3.7.4 During all MODES of operation, all snubbers shall be OPERABLE. All safety-related snubbers are listed in plant procedures.

APPLICABILITY: MODES 1, 2, 3, 4, 5 when the associated system/component is required to be OPERABLE.

-----NOTE-----

Snubbers located inside the drywell on reactor vessel attached piping shall be OPERABLE whenever fuel is in the reactor vessel. Snubbers on the Main Steam, HPCI, and RCIC piping, in the drywell, are exempt from the operability requirement when safety-related, seismically qualified steam line plugs are installed in the reactor vessel. If the associated supported systems are inoperable, snubbers inside the drywell on the Recirculation System, on the RHR System, and on the RWCU System are exempt from the operability requirements provided safety-related, seismically qualified plugs are installed both in the reactor vessel nozzles of the Recirculation System supply piping to the Recirculation System pump and the discharge nozzles of the Reactor Jet Pumps, and BFN-2-DRV-010-0505 is closed.

ACTIONS

-----NOTE-----

Separate condition entry is allowed for each system/train - not per snubber.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more snubber(s) inoperable.	A.1.1 Replace or restore the inoperable snubber(s) to OPERABLE status. <u>AND</u>	72 hours (continued)

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more snubber(s) inoperable (continued).	----------------NOTES---------------- 1. Only required if the snubber(s) do not meet the functional test acceptance criteria of TSR 3.7.4.2. 2. The evaluation must ensure the inoperable snubber did not adversely affect the supported component or system during the previous operating cycle. --	
	A.1.2 Perform an engineering evaluation to determine whether the snubber failure mode has adversely affected the supported component or system.	72 hours
	<u>OR</u>	
	A.2 Verify operability of the supported system based on an engineering evaluation of its functional capability with the inoperable snubber(s).	72 hours
	<u>OR</u>	(continued)

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more snubber(s) inoperable (continued).	A.3.1 Declare the supported system inoperable. (Refer to applicable TS and TRM LCOs). <u>AND</u> ----------------NOTE------------------ Only applicable to snubbers located inside the drywell on reactor vessel attached piping. -- A.3.2 Be in MODE 4 or 5.	72 hours 108 hours
B. One or more inoperable snubber(s) render(s) the supported system incapable of performing its function.	B.1 Declare the supported system inoperable. (Refer to applicable TS and TRM LCOs).	Immediately
C. Supported system declared inoperable due to one or more inoperable snubbers.	----------------NOTES----------------- 1. Only applicable while in MODE 4 or 5. 2. Only applicable to snubbers located inside the drywell on reactor vessel attached piping. (Excluding MS, HPCI, and RCIC piping when the steam line plugs are installed in the reactor vessel.). -- C.1 Verify by administrative means that two ECCS subsystems are in OPERABLE status.	 4 hours

(continued)

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
D. Required Action and associated Completion Time C not met.	D.1 Initiate action to restore two ECCS subsystems to OPERABLE status.	Immediately

---NOTES---

1. Each safety-related snubber shall be demonstrated OPERABLE by performance of the following augmented inservice inspection and test program and the requirements of this Technical Requirement. These snubbers are listed in plant procedures.
2. As used in this Technical Requirement, "type of snubber" shall mean snubbers of the same design and manufacturer, irrespective of capacity.
3. As used in this Technical Requirement, "population or category" shall mean the total number of snubbers being visually inspected as a lot.

TECHNICAL SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
TSR 3.7.4.1	---NOTE--- Snubbers are categorized as inaccessible or accessible during reactor operations. Each of these categories (inaccessible or accessible) may be inspected separately or jointly according to the schedule determined by Table 3.7.4-1. The visual inspection interval for a snubber population or category shall be determined based upon the criteria provided by Table 3.7.4-1. The first inspection interval determined using Table 3.7.4-1 criteria shall be based on the previous inspection interval established by the requirements in effect before Technical Specification Amendment 225 was issued. ---	
	Perform visual inspection of required snubber(s) based on the criteria of Table 3.7.4-1 for each population or category to verify: a. No visible indications of damage or impaired OPERABILITY; b. Attachments to the foundation or supporting structure are functional; and	In accordance with Table 3.7.4-1

(continued)

TECHNICAL SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
TSR 3.7.4.1 (continued)	c. Fasteners for the attachment of the snubber to the component or system and to the snubber anchorage are functional. The discovery of loose or missing attachment fasteners will be evaluated to determine whether the cause may be localized or generic. Snubbers which appear inoperable as a result of visual inspection shall be classified unacceptable and may be reclassified acceptable for the purpose of establishing the next visual inspection interval, provided that (1) the cause of the rejection is clearly established and remedied for that particular snubber and for other snubbers irrespective of type that may be generically susceptible; and (2) the affected snubber is functionally tested in the as-found condition and determined OPERABLE per the criteria of TSR 3.7.4.2. A review and evaluation shall be performed and documented to justify continued operation with an unacceptable snubber. If continued operation cannot be justified, the system or train shall be declared inoperable. Additionally, snubbers attached to sections of safety related systems that have experienced unexpected potentially damaging transients since the last inspection period shall be evaluated for the possibility of concealed damage and functionally tested, if applicable, to confirm OPERABILITY. Snubbers which have been made inoperable as the result of unexpected transients, isolated damage, or other random	

(continued)

TECHNICAL SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
TSR 3.7.4.1 (continued)	events, when the provisions of TSR 3.7.4.5 and TSR 3.7.4.6 have been met and any other appropriate corrective action implemented, shall not be counted in determining the next visual inspection interval.	
TSR 3.7.4.2	Perform an in-place or bench functional test of a representative sample of 10% of the total of each type of safety-related snubber(s). a. The representative sample selected for functional testing shall include the various configurations, operating environments, and the range of size and capacity of snubbers within the types; b. The representative sample should be weighed to include more snubbers from severe service areas such as near heavy equipment; c. The stroke setting and the security of fasteners for attachment of the snubbers to the component or system and to the snubber anchorage shall be verified.	24 months

(continued)

TECHNICAL SURVEILLANCE REQUIREMENTS

	SURVEILLANCE	FREQUENCY
TSR 3.7.4.2 (continued)	Functional Test Acceptance Criteria: The snubber functional test shall verify that: a. Activation (restraining action) is achieved in both tension and compression within the specified range, except that inertia dependent, acceleration limiting mechanical snubbers may be tested to verify only that activation takes place in both directions of travel. b. Snubber bleed or release, where required, is present in both compression and tension within the specified range. c. For mechanical snubbers, the force required to initiate or maintain motion of the snubber is not great enough to overstress the supported component or system during thermal movement, or to indicate impending failure of the snubber. d. For snubbers specifically required not to displace under continuous load, the ability of the snubber to withstand load without displacement shall be verified. e. Testing methods may be used to measure parameters indirectly or parameters other than those specified if those results can be correlated to the specified parameters through established methods.	

(continued)

TECHNICAL SURVEILLANCE REQUIREMENTS (continued)

	SURVEILLANCE	FREQUENCY
TSR 3.7.4.3	A failure analysis shall be made of each failure to meet the functional test acceptance criteria of TSR 3.7.4.2 to determine the cause of the failure. The result of this analysis shall be used, if applicable, in selecting snubbers to be tested in the subsequent lot in an effort to determine the OPERABILITY of other snubbers which may be subject to the same failure mode. Selection of snubbers for future testing may also be based on the failure analysis. For each failed snubber, perform in-place or bench functional test on an additional lot equal to 10% of the remainder of that type of snubber. Testing shall continue until no additional inoperable snubbers are found within subsequent lots or all snubbers of the original test type are tested or all suspect snubbers identified by the failure analysis have been tested, as applicable. The functional test criteria shall be as specified in TSR 3.7.4.2.	Once for each discovery of snubber failure to meet functional test acceptance criteria
	Prior to functional testing the discovery of loose or missing attachment fasteners will be evaluated to determine whether the cause may be localized or generic. The result of the evaluation will be used to select other suspect snubbers for verifying the attachment fasteners, as applicable.	Once for each discovery of loose or missing attachment fasteners

(continued)

TECHNICAL SURVEILLANCE REQUIREMENTS (continued)

	SURVEILLANCE	FREQUENCY
TSR 3.7.4.4	------------------------NOTE------------------------ This testing is independent of the requirements of TSR 3.7.4.3. -- For any snubber which fails to lockup or fails to move (i.e., frozen in place), evaluate the cause. If caused by manufacturer or design deficiency, perform in-place or bench functional test of all snubbers of the same design, subject to the same defect. The functional test acceptance criteria shall be as specified in TSR 3.7.4.2.	Once for each discovery of snubber failure to lockup or failure to move
TSR 3.7.4.5	Perform an engineering evaluation on the component or system which is restrained by the snubber(s) found inoperable due to not meeting their functional test acceptance criteria as specified in TSR 3.7.4.2.	Once for each discovery of an inoperable snubber
TSR 3.7.4.6	Verify replacement snubbers and snubbers having repairs which might affect the functional test results meet the test criteria of TSR 3.7.4.2. a. These snubbers shall have met the acceptance criteria subsequent to their most recent service; and b. The functional test must have been performed within the 12 months prior to being installed in the unit.	Once prior to installation in the unit for each replacement snubber and each snubber which has repairs which might affect functional test results

Table 3.7.4-1
Snubber Visual Inspection Interval

	NUMBER OF UNACCEPTABLE SNUBBERS		
Population or Category (Notes 1 and 2)	Column A Extend Interval (Notes 3 and 6)	Column B Repeat Interval (Notes 4 and 6)	Column C Reduce Interval (Notes 5 and 6)
1	0	0	1
80	0	0	2
100	0	1	4
150	0	3	8
200	2	5	13
300	5	12	25
400	8	18	36
500	12	24	48
750	20	40	78
1000 or more	29	56	109

Note 1: The next visual inspection interval for a snubber population or category size shall be determined based upon the previous inspection interval and the number of unacceptable snubbers found during that interval. Snubbers may be categorized, based upon their accessibility during power operation, as accessible or inaccessible. These categories may be examined separately or jointly. However, the licensee must make and document that decision before any inspection and shall use that decision as the basis upon which to determine the next inspection interval for that category.

Note 2: Interpolation between population or category sizes and the number of unacceptable snubbers is permissible. Use next lower integer for the value of the limit for Columns A, B, or C if that integer includes a fractional value of unacceptable snubbers as determined by interpolation.

Table 3.7.4-1 (Continued)
Snubber Visual Inspection Interval

Note 3: If the number of unacceptable snubbers is equal to or less than the number in Column A, the next inspection interval may be twice the previous interval but not greater than 48 months.

Note 4: If the number of unacceptable snubbers is equal to or less than the number in Column B but greater than the number in Column A, the next inspection interval shall be the same as the previous interval.

Note 5: If the number of unacceptable snubbers is equal to or greater than the number in Column C, the next inspection interval shall be two-thirds of the previous interval. However, if the number of unacceptable snubbers is less than the number in Column C, but greater than the number in Column B, the next interval shall be reduced proportionally by interpolation, that is, the previous interval shall be reduced by a factor that is one-third of the ratio of the difference between the number of unacceptable snubbers found during the previous interval and the number in Column B to the difference in the numbers in Columns B and C.

Note 6: The provisions of TSR 3.0.1, 3.0.2, and 3.0.3 are applicable for all inspection intervals up to and including 48 months.

Tennessee Valley Authority
Browns Ferry Nuclear Plant, Unit 2

Relief Request No. 2-ISI-40, Snubbers Inspection and Testing

Relief Request No. 2-ISI-40, Reference B

Browns Ferry Nuclear Plant, Technical Instruction, 0-TI-398,
"Snubber Program Procedure"

TVA

Browns Ferry Nuclear Plant

Unit 0

Technical Instruction

0-TI-398

Snubber Program Procedure

Revision 0009

Quality Related

Level of Use: Reference Use

Effective Date: 08-11-2010

Responsible Organization: DEC, Design Eng Civil

Prepared By: Channing Mitchell

Approved By: Eric Frevold

Current Revision Description

Pages Affected: All

Type of Change: REVISION Tracking Number: 010

This procedure is revised to incorporate the following changes:

Revised section 7.1 to incorporate the change made to Technical Requirement Manual TRM 3.7.4 "Snubbers" which address snubber operability with the installation of plugs in the Recirculation system piping.

Revised section 7.17.2 to incorporate the "as found" acceptance criteria for acceleration at activation for PSA mechanical model snubbers.

Revised Appendix F to incorporate empirical data for Service Life Monitoring Recommendation for selected models of snubbers at BFN and to address PER 228011 action 003; service life monitoring for PSA-10 mechanical model snubbers installed in high temperature applications.

Revised Appendix C to delete Grinnell Hydraulic Snubbers based on the implementation of DCN 69563. Appendices were renumbered accordingly.

Revised sections 1.2, 7.62, 7.14.2, 8.0, Appendix J, and Appendix L to reflect the approval by the NRC of Relief Request 1-ISI-18.

Added Appendix M to reflect Lisega Type 30 hydraulic snubbers installed by DCN 50287 and DCN 69563.

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1.0 INTRODUCTION

1.1 Purpose

The purpose of this Technical Instruction (TI) is to provide a single source of guidance, explanations, and information, with regard to snubbers, that is required to establish and maintain the Browns Ferry Snubber Program. The more knowledgeable reader will be able to utilize this document to examine, evaluate, and/or administer the Browns Ferry Snubber Program.

1.2 Scope

A. This TI applies to all mechanical and hydraulic snubbers, safety-related or non-safety-related.

B. This TI applies to TVA employees, contractor, and vendor employees involved with snubber inspection, testing, maintenance, procurement, storage, design, installation, or modification.

C. Snubber program regulatory requirements apply only to safety-related snubbers.

D. Snubber program satisfies alternative to sub-article, IWF-5300 and IWA-6230 of Section XI of the ASME Code requirements for Unit 3 per NRC approval of "Snubber Request for Relief 3-ISI-2", dated December 12, 2006.

E. Snubber program satisfies alternative to sub-article, IWF-5300 and IWA-6230 of Section XI of the ASME Code requirements for Unit 2 per NRC approval of "Snubber Request for Relief 2-ISI-13", dated January 7, 2003.

F. Snubber program satisfies alternative to sub-article, IWF-5300 and IWA-6230 of Section XI of the ASME Code requirements for Unit 1 per NRC approval of "Snubber Request for Relief 1-ISI-18", dated April 2, 2009.

2.0 REFERENCES

2.1 Source References

A. API/Barker STB-200 Snubber Test Bench Manual

B. API/Barker STB-200 Snubber Test Bench Software Quality Assurance Plan

C. BFN-VTM-B209-0160, Vendor Technical Manual For Bergen-Paterson Reactor Torus Ring Hydraulic Shock Suppressors.

D. BFN-VTD-B209-0180, Installation Techniques For Bergen-Paterson Series 78000 Hydraulic Shock Suppressors.

E. BFN-VTD-B209-0200, Removal Techniques For Bergen-Paterson Series 78000 Hydraulic Shock Suppressors.

F. BFN-VTM-P029-0010, Vendor Technical Manual for Pacific Scientific Instruction Manual for Repair, Overhaul, Installation Maintenance of Mechanical Shock Arrestors.

G. BFN-VTD-P029-0050, Pacific Scientific Instruction Manual Installation and Maintenance Mechanical Shock Arrestors Models PSA-1/4, PSA-1/2, PSA-1, PSA-3, PSA-10, PSA-35, PSA-100

H. BFN-VMM-P029-0250, Vendor Miscellaneous Manual For Pacific Scientific Mechanical Shock Arrestors.

I. BFN-VTM-L329-0010, Vendor Technical Manual For Lisega Reactor Torus Ring Hydraulic Snubbers

J. BFN-VTD-L329-0070, Installation and Maintenance Instructions For Lisega Hydraulic Snubbers

K. Relief Request 3-ISI-2 (TAC NO. M97805), dated May 3, 1999 NRC Letter, "Browns Ferry Nuclear Plant, Unit 3 - Relief From ASME Boiler and Pressure Vessel Code, Section XI Requirements

L. Technical Requirements Manual (TRM) Technical Requirement TR 3.7.4, "Snubbers"

M. Relief Request 2-ISI-13 (TAC NO. MB6596), dated January 7, 2003 NRC Letter, "Browns Ferry Nuclear Plant, Unit 2 - Relief From ASME Boiler and Pressure Vessel Code, Section XI Requirements

N. 1-SI-4.6.G, "ASME Section XI"

2.1 Source References (continued)

O. A Snubber Response Sensitivity Study, A.T. Onesto, Energy Technology Engineering Center (ASME Technical Conference Paper PVP-37 "Piping Restraint Effect on Piping Integrity" June 1979). Reference Engineering Memorandum to H.J. Green Director of Nuclear Power; From M.N. Spouse Manager of Engineering Design: Dated May 2, 1983. (CEB 83 0502 003)

P. Relief Request 1-ISI-18 (TAC NO MD8797), dated April 2, 2009 Browns Ferry Nuclear Plant, Unit -1 Safety Evaluation for Relief Request 1-ISI-18 Associated with Inspection and Testing of Snubbers

2.2 Developmental References

A. General Engineering Specification G-43, "Installation, Modification, and Maintenance of Pipe Supports and Pipe Rupture Mitigative Devices"

B. 0-TI-363, ASME Section XI Repair and Replacements

C. 1-SI-4.6.H-1, Visual Examination of Hydraulic and Mechanical Snubbers

D. 2-SI-4.6.H-1, Visual Examination of Hydraulic and Mechanical Snubbers

E. 3-SI-4.6.H-1, Visual Examination of Hydraulic and Mechanical Snubbers

F. 0-SI-4.6.H-2A, Functional Testing of Mechanical Snubbers

G. Canceled and Superseded by 0-SI-4.6.H-2A.

H. Canceled and Superseded by 0-SI-4.6.H-2A.

I. 0-SI-4.6.H-2B, Functional Testing of Bergen-Paterson, Anchor Darling, Fronek Hydraulic Snubbers

J. Canceled and Superseded by 0-SI-4.6.H-2B.

K. Canceled and Superseded by 0-SI-4.6.H-2B.

L. 0-SI-4.6.H-2C, Functional Testing of Bergen-Paterson Torus Dynamic Restraints

M. Canceled and Superseded by 0-SI-4.6.H-2C.

N. Canceled and Superseded by 0-SI-4.6.H-2C.

O. 0-SI-4.6.H-2D, Functional Testing of Grinnell Hydraulic Snubbers

P. Canceled and Superseded by 0-SI-4.6.H-2D.

2.2 Developmental References (continued)

Q. 0-SI-4.6.H-2E, Functional Testing of Large Bore Lisega Torus Dynamic Restraint Snubbers

R. Canceled and Superseded by 0-SI-4.6.H-2E.

S. MPI-0-000-SNB002, Hydraulic Shock and Sway Arrestor Bergen-Paterson, Anchor Darling, Fronek Unit Disassembly and Reassembly

T. MPI-0-000-SNB004, Instructions for Removing and Reinstalling Pacific Scientific Mechanical, Bergen-Paterson, Anchor Darling, Fronek, and Bergen-Paterson or Lisega Torus Dynamic Snubbers

U. NUREG/CR-5870, Results of LWR Snubber Aging Research, Published May 1992

V. SPP-3.1, Corrective Action Program

W. SPP-8.1, Conduct of Testing

X. SPP-9.1, ASME Section XI

Y. Snubber Technical and ISI Review Course, by Lake Engineering Company, Warwick, Rhode Island

Z. MPI-0-000-SNB005, Visual Examination of BOP Hydraulic and Mechanical Snubbers

AA. Engineering Program Guide - Snubbers, Good Practice EPG-07, Institute of Nuclear Power Operations, July 2006

BB. 2004 Edition of the ASME Code for Operation and Maintenance of Nuclear Power Plants

CC. 0-SI-4.6.H-2F, Functional Testing of Lisega Type 30 Hydraulic Snubbers

3.0 DEFINITIONS

A. Activation (Lockup) - The change of condition from passive to active, in which the snubber restrains the rapid displacement of the supported system/component.

B. API/BARKER Test Bench - An automated mechanical test device designed to perform functional testing of snubbers. The current name of the test bench vendor is Barker/Diacon.

C. As-Found Test - As-found test means the snubber must be tested without performing any kind of maintenance on the snubber. Also any cleaning of the snubber exterior surface is precluded. Stroking of the snubber prior to testing should be avoided, however, test sequence (i.e. activation is to be done first or drag force test is to be done first) is insignificant.

D. Bench Testing - Functional testing of snubbers utilizing the STB-200 or similar equipment.

E. Bleed Rate (Release) - The rate of snubber axial movement under a specified load after activation of the snubber takes place.

F. Breakaway Force - The minimum applied force to initiate extension or retraction of the snubber.

G. Drag Force - The force required to maintain snubber movement at a low velocity or acceleration before activation.

H. Fasteners - Securing devices such as lock wire, locking tabs, jam nuts, attachment welds, cotter pins, etc. which can be detected by visual observation.

I. Freedom-of-Motion, or Push-Pull Method - Manual stroking of snubber through its full range of motion. This is commonly used to check suspected snubbers for damage due to transients.

J. Functional Testing - Measurement or checks of parameters that verify operational readiness.

K. Hydraulic Snubber - Snubbers in which load is transmitted through a hydraulic fluid. Hydraulic snubbers are equipped with control valves which defeat the restraining action of the snubber, allowing it to move relatively freely until a specific velocity called activation or lock-up velocity is reached. At this velocity the control valve closes and the snubber starts to restrain the velocity of the attached component.

L. Maintenance - Action taken to prevent and correct deficiencies in the function of a snubber.

3.0 DEFINITIONS (continued)

M. Mechanical Snubber - Snubber in which load is transmitted entirely through mechanical components. Mechanical snubbers are designed to restrain pipe or equipment to a specific limited acceleration or rate of velocity change during an event. For normal thermal motion the snubber will move freely in either direction through its operating stroke.

N. Operable - The ability of a snubber to perform its intended design function.

O. Snubber - Dynamic restraints which are utilized to allow slow, constant movement of a supported system/component while providing rigid restraint against rapid motion due to dynamic loads (i.e., earthquakes, transients, etc.).

P. Spacers - Devices located on each side of the spherical bearing used to position the snubber clevis attachment in the center of the end attachment. These are also known as washers.

Q. Spherical Bearing - Load bearing which allows the snubber to rotate in the end attachments.

R. Stroke - Full length of the total possible snubber movement.

S. Technical Requirements Manual Snubber - Snubbers that are required for safe shutdown, required to protect code boundaries and to ensure system/component structural integrity under dynamic loads. These are known as Essential, Safety-related or Quality-related.

T. Thermal Movement - The amount the system/component is analytically predicted to move from its Cold position to its Hot (Operating) position during normal or emergency system operation. Thermal movement can be either in tension or compression and this movement is identified on the support design drawings.

U. Unstaked, Internal - Rotation occurs between the support cylinder and the position tube indicator, for Mechanical snubbers.

V. Unstaked, spherical Bearing - Spherical bearing, used for snubber alignment, is found displaced from the paddle plate.

W. Visual Examination - The performance of visual observations for detection of improper installation and impaired functional ability caused by physical damage, leakage, corrosion, or degradation from environmental or operating conditions.

X. Work Implementing Document (WID) - Workplan, Maintenance Instruction, Work Order, or other similar document which consists of written directions for performance of work.

4.0 GENERAL PRECAUTIONS

None

5.0 PREREQUISITES

None

6.0 EQUIPMENT

None

7.0 PROCEDURE

7.1 General

Snubbers are dynamic restraints that are utilized to allow slow, constant movement of a supported system/component while providing rigid restraint against rapid movement due to dynamic loads. Snubbers are installed on piping and/or equipment primarily to limit the displacement of the piping or equipment during a seismic event or during a severe transient. They are sometimes installed to limit damage from pipe break, vibration, and water hammer. Snubbers accomplish this by absorbing the energy from the supported system/component motion and transmitting it to the building structure.

Snubbers can directly affect plant safety, therefore, periodic inspection, testing, and appropriate maintenance is required to ensure their operability. Inoperable snubbers may severely damage piping or equipment either by **NOT** restraining them during a seismic event or transient, or by **NOT** allowing thermal expansion during normal plant operation.

Technical Requirements Manual (TRM) Technical Requirement (TR) 3.7.4, "Snubbers", requires all safety-related snubbers to be operable during all modes of operation. However, if a component or system affected by the snubber(s) is **NOT** required to be OPERABLE, then the snubber is **NOT** required to be OPERABLE, except as follows: The snubber(s) on Main Steam, HPCI and RCIC piping, in the drywell, are exempt from this requirement when safety related, seismically qualified steam line plugs are installed in the reactor vessel. For each Recirculation System Loop, if the associated supported systems are inoperable, snubbers inside the drywell on the Recirculation System, on the RHR System, and on the RWCU System are exempt from the operability requirements provided safety-related, seismically qualified plugs are installed both in the reactor vessel nozzles of the associated Recirculation System Loop supply piping to the Recirculation System pump and the associated Loop discharge nozzles of the Reactor Jet Pumps, and the applicable drain valve BFR-1 DRV-010-0505, BFN-2-DRV-010-0505, or BFN-3-DRV-010-0505 is closed. During the times snubber(s) are **NOT** required to be OPERABLE for an inoperable system, the inoperable snubber(s) will be tracked to prevent declaring the system OPERABLE with unanalyzed inoperable snubber(s).

At the present time there are three manufacturers and five types of snubbers at Browns Ferry. The manufacturers are Bergen-Paterson (also known as Anchor/Darling or Fronek), Lisega and Pacific Scientific Company Mechanical Snubbers. The types and pertinent information about each will be given in Appendix B, C, D, and E of this procedure.

7.2 Program Ownership

The snubber program is maintained by the Site Engineering, Civil Engineering Group. The primary owner of the program is the Site Snubber Program Engineer (SSPE). The SSPE should have a broad knowledge of plant systems and shall be cognizant of snubber inspections and testing requirements.

7.3 Duties and Responsibilities

A. The SSPE responsibilities are as follows:

1. Ensures overall snubber operability and compliance with TR 3.7.4 requirements and other snubber related regulatory requirements.
2. Maintains the technical adequacy and accuracy of snubber program procedures.
3. Performs revisions and develops new procedures for snubbers, as required.
4. Implementation of program procedures.
5. Initiates all Work Orders for snubber work to be performed prior to and during the outage (i.e., removal and reinstallation, rebuild and functional testing).
6. Provides information to Planning for completion of ASME Section XI Repair and Replacement paperwork, Section XI NIS-2 form and Work Order, as required.
7. Ensures that proper maintenance is scheduled and performed on snubbers.
8. Ensures adequate inventories of required snubbers and spare parts.
9. Issues purchase request for snubber spare parts and personnel services, as required.
10. Updates the snubber tracking program with required information, as required.
11. Reviews and evaluates all snubber test data to ensure it meets all acceptance criteria.
12. Performs failure analyses and other evaluations of failed and degraded snubbers.
13. For Unit 1, 2, and 3 has primary responsibility for the implementation of the ASME Section XI inspection program for snubbers.

7.3 Duties and Responsibilities (continued)

14. Maintains the Snubber Program Notebook

15. Maintains the Snubber Program Health Report

16. Other duties include: reviews applicable Industry and TVAN operating experience (OE); reviews applicable TVAN PER; forwards BFN specific issues and concerns to TVAN Snubber Peer team to engage dialogue for issue resolution; participates in SNUG and other industry related forums; determines the need for continuing training; and performs periodic industry benchmarking.

7.4 Interfaces

7.4.1 Operations

A. Ensures compliance with Technical Specification and Requirements Manuals by determining when removal of snubbers for testing or maintenance is allowed based on plant conditions.

B. Tracks all Limiting Conditions Of Operation (LCOs) for snubbers.

C. Approves and tracks Work Orders for snubbers being worked.

7.4.2 Mechanical Maintenance

A. Supports surveillance activities by performing the removal, rebuild, installation and transport of all hydraulic snubbers.

B. Performing the removal, installation and transport of some mechanical snubbers.

C. Performs maintenance and repairs of failed or degraded snubbers.

D. Performs all visual examinations, as required.

E. Provides necessary information to the SSPE to ensure proper updating of snubber program procedures

7.4.3 Site Engineering - Design

A. Provides clear and concise design requirements for both TVA and vendor installed equipment to ensure that all regulatory and Browns Ferry site specific requirements are met relative to snubbers.

B. Defines and evaluates test acceptance criteria which is **NOT** met.

C. Performs Supported System/Component Analyses for inoperable snubbers.

D. Reviews and updates the snubber unique identifier list (Master Equipment List) in EMPAC.

7.4.4 Modifications

A. Deletes, installs, and/or modifies snubber supports in accordance with design output documents.

B. Provides necessary information to the SSPE to ensure proper updating of snubber program procedures.

7.4.5 Materials and Procurement

A. Procures and stores snubbers, snubber parts, support parts and hardware, in accordance with procurement documents.

B. Maintains an adequate inventory of new spare parts, as specified by the SSPE, to ensure availability of parts for maintenance.

7.4.6 Component Engineering

A. For Unit 1, 2, and 3 has primary responsibility for the implementation of the ASME Section XI inspection program for snubbers.

B. Has responsibility for the implementation of the ASME Section XI Repair and Replacement Program.

7.4.7 Planning and Scheduling

A. Coordinates with the SSPE for snubber surveillance activities to be performed for operating cycle. Snubbers installed on systems that are inside the drywell are to be scheduled for testing or maintenance during those system outages, if possible, so that system operability will **NOT** be affected. Scheduling of the Torus Restraint Snubbers for testing and maintenance must be performed during the refuel outage and coordinated with the SSPE to ensure the proper contracts are in place.

B. Prepares and obtains approvals on ASME Section XI Repair and Replacement paperwork, Section XI NIS-2 forms and Work Orders.

7.5 Regulatory Requirements

A. The Units 1, 2, and 3 Technical Requirement Manual (TRM) 3.7.4 contains the snubber surveillance requirements and Limiting Conditions for Operation (LCO). Every requirement in the TRM should be reviewed carefully and should be specifically incorporated in the plant surveillance instructions.

B. Adverse condition reporting requirements shall be in accordance with SPP-3.1, "Corrective Action Program".

C. Those safety-related snubbers on the portions of systems covered by Section XI are subject to the requirements of SPP-9.1, ASME Section XI.

D. The ASME Section XI Repair and Replacement process shall be performed in accordance with 0-TI-363, ASME Section XI Repairs and Replacements.

E. The ASME Section XI requirements have been modified by the approval of Request for Relief 3-ISI-2, shown in Appendix A of this procedure.

F. The ASME Section XI requirements have been modified by the approval of Request for Relief 2-ISI-13, shown in Appendix I of this procedure.

G. The ASME Section XI requirements have been modified by the approval of Request for Relief 1-ISI-18, shown in Appendix J of this procedure.

7.6 Snubber UNIDs, Lists, and Drawings

7.6.1 Unique Identifiers (UNIDs)

Each snubber is represented on a pipe support drawing. The Unique Identifier Number (UNID) is a unique number with the Plant - Unit - Function Code - Unique No. The function code should be SNUB and the Unique No. should begin with 5001 for each system. The Torus Restraint Snubber Unique No. begins with 0001. The UNIDs should be accurately recorded on the WOs to properly identify and retrieve information for work performed on the snubbers. Site Engineering, Civil Design is responsible for maintaining the UNID list.

7.6.2 Snubber Lists

A. An accurate list of all safety-related/quality related snubbers is required to ensure implementation of Technical Requirement 3.7.4. The Unit 1 safety-related snubber list is provided in Surveillance Instruction 1-S1-4.6.H-1, the Unit 2 safety-related snubber list is provided in 2-SI-4.6.H-1, and the Unit 3 safety-related snubber list is provided in 3-SI-4.6.H-1. The list contains snubber number, system No., type, size, and location, as a minimum. The listing will include the drawing number and the Inservice Inspection (ISI) isometric drawing number. Non-safety related snubbers are listed in MPI-0-000-SNB005.

B. The SSPE shall update the snubber listing in 1-SI-4.6.H-1, 2-SI-4.6.H-1, and 3-SI-4.6.H-1 when the design change process adds, deletes, or changes the type of existing snubber. Update of the snubber listing shall be made after implementation of the modification. If maintenance work is performed which changes any information in the procedures, the updates should be completed as soon as practical after the change has been completed.

7.7 Outage Planning and Preparation

Outage planning and preparation should begin, as a minimum, approximately six months prior to the scheduled refueling outage (RFO). This is needed to obtain any required contract services and to review spare snubbers and spare parts inventories.

7.7.1 Previous SI Performance

The previous SI data sheets performance information from the snubber database should be reviewed to determine any specific issues that should be addressed for the next scheduled Visual Surveillance or testing interval, i.e., pre-outage and outage. Some examples are:

A. Previous functional failures due to location

B. Snubbers requiring service life monitoring

C. Recurring visual deficiencies and test failures

D. Whether the visual exams are required during this operating cycle

7.7.2 Hydraulic Snubber Seal Service Life

A. Review the snubber database and determine which hydraulic snubbers seal service life will expire prior to the next scheduled RFO. These should be scheduled for rebuild or identified for a seal life extension study.

B. Ensure an adequate supply of parts, necessary to rebuild snubbers, including seals and load-bearing/pressure-retaining parts (i.e., cylinder, piston, piston rod, tie rods, control valves, etc.) are available. Also review spare snubber availability.

C. Initiate work orders to rebuild the required selected snubbers.

7.7.3 Functional Test Sample

A. Select a functional test sample of 10 % of each subgroup in accordance with the plant SI, preferably with the aid of the snubber database.

1. Consider the snubbers to be rebuilt to select the initial and possible second sample.

2. Identify candidates for possible additional samples for each subgroup.

B. Review the snubber database, visual inspection procedures and past performances to determine scaffolding and other restraints.

7.7.4 Functional Testing of Large Bore Hydraulic Snubbers

A. Since TVA does **NOT** own the necessary test equipment, initiate purchase request for onsite testing of the Bergen-Paterson Torus Dynamic Restraint snubbers. The vendor should have the capability of in-place testing.

B. Establish schedule for bringing vendors on and off site to minimize impact to other support activities. Consider scheduling contractor training at the least cost location and before the outage begins, if required.

C. The Lisega Type 31 21 50 Torus Restraint Snubbers may be tested on TVA's API/Barker STB-200 test bench using the Surrogate snubber furnished by Lisega. To satisfy the Technical Requirements Manual only the poppet valves from the Lisega Type 31 21 50 restraint are installed in the Surrogate snubber and tested. The Surrogate snubber test results are then converted to the Lisega Type 31 21 50 restraint values using conversion factors in 0-SI-4.6.H-2E, Attachment 2, Page 1 of 5.

7.8 Receipt Inspection and Storage of Snubbers

7.8.1 Receipt Inspection

> **NOTE**
>
> The SSPE should be notified if the receipt inspection reveals any damage or dimensional discrepancy.

Snubber receipt inspection must be performed in accordance with the contract document and site Nuclear Stores procedure, SPP-4.2, Material Receipt and Inspection. Proper receipt inspection and storage of mechanical and hydraulic snubbers have a significant impact on the performance of the snubber after installation. Personnel involved in receipt inspection of snubbers are required to ensure proper care for handling and storage techniques in accordance with site procedures.

7.8.2 Storage of Snubbers After Initial Receipt Inspection and Prior To Installation (Nuclear Stores)

A. The snubber storage should be in buildings designated for storage.

B. Storage and Handling shall be performed as required in site Nuclear Stores procedure SPP-4.3, Material Storage and Handling. In part, this prescribes, "Items shall be protected from exposure to salt, spray, rain, dust, dirt, and other airborne and windblown contaminants."

C. When practicable, snubbers should be stored in their shipping container, if the container provides protection to the snubber. Packages should be labeled for easy identification of the snubber.

D. The snubbers, after removal from nuclear stores, should be protected from rain and the possibility of moisture or other liquids entering the snubber. They should also be protected from sand blasting or other activities that might result in foreign particles entering the snubber.

E. Hydraulic snubber repair kits containing elastomeric parts should be treated as finite shelf-life components in accordance with applicable shelf-life programs.

7.8.3 Storage of Snubbers After Removal From Nuclear Stores or the Plant

A. The snubber test/rebuild facility has been designated as a "B" Level Storage area.

B. The requirements for a "B" Level Storage area are as follows:

1. Should be a fire resistant, tear resistant, weather tight, and well ventilated building or equivalent enclosure.
2. The area shall be situated and constructed so that it will **NOT** be subject to flooding.
3. Items shall be stored to permit air circulation.
4. The area shall be provided with temperature and humidity control or equivalent to prevent condensation and corrosion.
5. The minimum temperature shall be 40 degrees F and the maximum shall be 140 degrees F.
6. The storage area shall be clearly identified as to its storage level.
7. Verification of the storage conditions shall be provided by calibrated recorders and shall be documented.
8. Limit and control access to the storage area.
9. Lock storage area when **NOT** attended by an authorized person.
10. Inspect and document on a semi-annual basis that storage area and stored items are maintained.
11. The inspection shall be performed by an ANSI N45.2.6, Level II inspector, and documenting it on the inspection report form, Appendix E of SPP-4.3.

A sign designating the facility, as a "B" Level Storage Area, has been placed on the door.

Access is controlled by a key lock. Only a limited number of keys are available for access to the facility.

Only "Authorized Personnel" will be allowed entry into the facility without an escort. A list of "Authorized Personnel" will be issued and updated by the SSPE and the Mechanical Maintenance Manager. A copy of the list will be placed in the Duty Mechanical Maintenance Manager's log, placed on the door of the facility and other logs, as decided by management.

7.9 ALARA Planning

The SSPE must coordinate with RADCON to develop an ALARA preplanning package for the total scope of the snubber surveillance to be performed for the operating cycle. ALARA briefings should be held between RADCON and the test performers to explain high-rad areas, contamination, dress-out, stay times, and minimizing radwaste requirements.

7.10 In-Service Inspection (ISI) (ASME Section XI Requirements)

To fulfill Code of Record certification, in accordance with repair/replacement requirements of Section XI, ensure that information is readily available (i.e., original purchase specification, for new snubbers received from Nuclear Stores, and previous location, UNID and removal work document (if possible) of used snubbers being stored as spares in the snubber test/rebuild facility, for each snubber mark number within the Section XI boundary) to facilitate timely completion of work order documentation.

The ASME Section XI Inservice Inspection of snubbers, for Unit 1, shall meet the requirements of this program as documented on the snubber request for relief in Appendix J. This request for relief is referenced in Section 2.1P.

The ASME Section XI Inservice Inspection of snubbers, for Unit 2, shall meet the requirements of this program as documented on the snubber request for relief in Appendix I. This request for relief is approved as referenced in Section 2.1M.

The ASME Section XI Inservice Inspection of snubbers, for Unit 3, shall meet the requirements of this program as documented on the snubber request for relief in Appendix A. This request for relief is approved as referenced in Section 2.1K.

7.11 Spare Snubbers

A. Special emphasis should be placed on having in stock approximately 10 percent of the unit population of PSA 1/4 and PSA 1/2 mechanical snubber spares.

B. Based on improved reliability of the larger models of PSA mechanical snubbers, a stock of from 3 to 5 percent, of those sizes as spares, should be sufficient.

C. Hydraulic snubbers should be available as spares for snubbers which must be functionally tested under a Technical Requirement Limiting Condition for Operation (LCO).

D. Hydraulic snubber metallic and non-metallic parts must be verified for availability for those hydraulic snubbers scheduled to be refurbished for the RFO.

E. Spare snubbers for the Torus Dynamic Restraints are manufactured by Lisega and are approved as replacements for the Bergen-Paterson snubbers when removed. This replacement was approved under Design Change Notice V39267A.

7.12 Functional Test Equipment

A. Ensure the API/Barker snubber test benches calibration due dates will remain valid for the duration of the RFO.

B. If snubber end attachments are removed, from the snubber, for functional testing and a torque wrench is used to reinstall them, the torque wrench shall be post-use calibration checked after each torque performance to reduce the risk of having to retorque the end attachments, especially in the drywell, if the torque wrench is found out of calibration after extended use.

7.13 SI Performance Team and Facilities

A. Prior to the RFO, manpower requirements must be determined to include the following:

1. Test director
2. Assistant/backup test director (outage snubber coordinator)
3. Functional test performance personnel (teams include technician or engineer and craft personnel)
4. Visual examination personnel (may be performed by craft personnel with review of possible anomalies by technician or engineer)
5. Hydraulic snubber test performance personnel (machine operator and craft personnel with engineering oversight)
6. Hydraulic snubber rebuild personnel (performed by craft/contract personnel with engineering oversight)
7. Computer data base entry personnel (engineer or technician)

B. Facilities should be made available to include the following:

1. Office space sufficient to coordinate snubber program team meetings with area to spread flow drawings, etc.
2. Test and rebuild facility with enough room for desk, file cabinet, two test benches, control center, 2 rebuild tables, tool boxes (with an assortment of hand tools and wrenches) and other required equipment, monorail(s) or other appropriate equipment to move snubbers around the facility and a fluid storage area with fire proof cabinet.
3. Personal computer with snubber tracking data base.

7.14 Training and Qualification of Performers

7.14.1 General

A. Thorough briefings should be conducted on SI performance of visual inspections and functional testing.

B. Cognizant personnel must be qualified as test director in accordance with plant administrative procedures.

C. Appropriate GET training (including respirator training) should be received by test personnel to perform the SI.

D. GET training for contract personnel should be arranged to minimize expense and expedite getting on and off site.

E. The designated backup to the SSPE shall be trained to the requirements of the SSPE. The backup to the lead Maintenance staff shall be trained to the requirements of the lead Maintenance staff. The SSPE will meet the qualifications card requirements for a snubber engineer and the Maintenance staff will have the necessary task specific qualifications.

F. Specific training requirements will be described under each section.

The training is performed to meet INPO, general regulatory requirements, and good business practices.

7.14.2 Visual Examinations

A. The training for the visual exams should include orientation to the requirements of the Surveillance Instructions. Training aids should include actual snubbers and examples of discrepancies that should be noted on the data sheets for further review.

B. Personnel performing the visual inspections of 1-SI-4.6.H-1, 2-SI-4.6.H-1 and 3-SI-4.6.H-1 must meet the visual acuity requirements of ASME Section XI, Code, 2001 Edition, 2003 Addenda, Paragraph IWA-2321.

7.14.3 Functional Tests of Hydraulic Snubbers

The operation of the test machines or test benches requires extensive training on the operation of the specific piece of equipment and thorough knowledge of the snubber design and test parameters. The best results should be obtained using engineers or technicians who may be assigned to the program on a continuing basis. Since this training should be performed by the test bench manufacturer or another qualified person, the training costs will be high, inefficient performance during outages, and invalid rejects may result when different personnel are used.

7.14.4 Rebuilding Hydraulic Snubbers

The rebuilding of hydraulic snubbers is typically assigned to personnel who are familiar with the requirements through experience. Additional basic training is required for personnel who have **NOT** previously rebuilt hydraulic cylinders and control valves. The training should include classroom instruction, practical demonstration and practice in the actual rebuilding of snubbers. Most of the training at Browns Ferry has been performed as On-the-Job Training (OJT) by personnel who are experienced and knowledgeable with the rebuilding of snubbers.

7.14.5 Functional Tests of PSA Mechanical Snubbers

The training for drag force testing of PSA snubbers should include orientation on the operation of the snubber and the drag force effect on the piping. Actual snubbers and the STB-200 Test Bench should be demonstrated and used by the students to learn the proper technique of functional testing the snubber through its stroke. The entire requirement for stroking and as-left testing should be included.

The method for determining activation should be discussed, demonstrated, and practiced by the students.

7.14.6 Rebuilding PSA Mechanical Snubbers

The PSA mechanical snubber is a complex mechanism and the manufacturer recommends they provide the training. The manufacturer will issue a rebuild training certificate, which is required to be renewed every two years. Some vendors have been authorized by the Original Equipment Manufacturer (OEM) to provide the training and some of those in TVA who have taken the training may be qualified to teach others. The rebuilding requires careful attention to many details and precision measurement in some cases. The training should include classroom instruction, practical demonstration, and practice in actual rebuilding. Special tooling is required and post maintenance tests shall be included to verify the rebuilding has been performed correctly. Browns Ferry does **NOT** rebuild mechanical snubbers, at this time, due to the extensive training and cost of purchasing and storing spare parts.

7.15 Visual Examination Program

The following applies to the regulatory requirements of safety-related and quality-related snubbers only. Other aspects of the program are contained in the section on "Balance of Plant Hydraulic and Mechanical Snubbers."

7.15.1 Scope and Frequency

A. This program covers safety-related and quality-related snubbers, of which ASME Section XI snubbers are a subset. The visual examination shall verify that:

1. There are no visible indications of damage or impaired operability.
2. Attachments to the foundation or supporting structure are functional.
3. Fasteners for attachment of the snubber to the component and to the snubber anchorage are functional.

B. Safety-related snubbers require visual examinations on an interval determined by the number of unacceptable snubbers found, during the visual examination process, using Table 3.7.4-1 in the Technical Requirements Manual TR 3.7.4. The basis of this frequency is provided in NRC Generic Letter 90-09. Removal of insulation is **NOT** required. Each time the performance is required the total population of the snubbers in the accessible or inaccessible category are required to be examined. The change in the frequency table described in the TRM requires that all the snubbers be examined either as separate categories or combined into one population. The table is more favorable if the snubbers are considered one population, and that usually is the choice that should be made and documented before the examinations begin.

C. At Browns Ferry the decision has been made to count all snubbers as one group and this decision is documented in the unit specific SI. Based on past examinations, the results should permit skipping alternate outages and permit an interval between examinations up to 48 months.

7.15.2 Visual Inspection Package

A. This package is the SI procedure and should be performed by locations, with ALARA considerations in mind, to minimize time spent or re-traveling through high radiation areas.

B. In the process of performing visual examinations, special attention should be given to potential problems of snubbers which must be functionally tested, i.e., scaffolding/ladder required, total removal required, high radiation levels, etc.

7.15.3 Examination Items

The examination items are specified in the TRM. Additional detail shall be provided in the Surveillance Instructions. A check list of the items to be observed are clearly specified and data sheets have been developed to document examination results. These data sheets are located in Attachment 2 in 2-SI-4.6.H-1 and 3-SI-4.6.H-1 and Attachments 2, 3, and 4 in 1-SI-4.6.H-1. The Surveillance Instruction requires the completion of the appropriate Attachments for each snubber visually examined.

7.15.4 Resolution of Anomalies

Many discrepancies can be found during the exams, but few actually result in inoperability of the snubber. All of the anomalies should be reviewed and dispositioned by an individual very knowledgeable in the operability requirements of the snubbers. A case of low fluid level may be resolved by functional test to verify the snubber will activate, followed by resolution of the leak. If a reservoir is found completely empty, the snubber shall be declared inoperable until a functional test has been performed, the results found acceptable and the leak has been resolved. Mechanical snubbers that are suspected of being bound up may be stroke tested to verify they are **NOT** bound up. Most other anomalies will require minor maintenance, if any action at all. All anomalies shall be handled in accordance with SPP-3.1, Corrective Action Program.

7.16 Decontamination

7.16.1 General Considerations

A. Since the Snubber Rebuild and Test Facility is located in the Turbine Building, any snubber transported to the facility must satisfy RADCON requirements.

B. Therefore, sometimes decontamination of snubbers may be necessary. A major consideration in decontaminating snubbers is avoiding changing the as-found condition (i.e., stroke setting) of the snubbers selected for as-found testing. Therefore, the ability to test the snubbers with a minimum amount of decontamination is desirable, but the inconvenience of testing and rebuilding contaminated snubbers can add significantly to the cost and time required for testing to be completed.

7.16.2 Decontamination of Mechanical Snubbers

A. Mechanical snubbers are **NOT** water-tight. Where possible, these snubbers should be decontaminated by wiping with a dry cloth or using a foam cleaner rather than immersion into a cleaning fluid. Fluid that has entered the snubber may become trapped and eventually cause corrosion. Unless the snubber has been subjected to intrusion of contaminated fluid, the inside of the snubber should be free of contamination.

7.16.3 Decontamination of Hydraulic Snubbers

A. Hydraulic snubbers are more resilient than mechanical snubbers. The only time a hydraulic snubber may have problems during decontamination is if high pressure water is used to remove the contamination. If this occurs care should be taken **NOT** to spray directly at the front rod wiper. The water pressure could force water past the rod wiper and the piston rod packing, since these seals are made to pressurize from the inside of the snubber. Water which has been forced into the snubber could affect the functional test results.

B. Decontamination of hydraulic snubbers should be carefully controlled, especially for those that have a suspected low fluid level and supplied by a gravity feed reservoir. If the fluid used to decontaminate the snubber seeps into the reservoir, or the reservoir is disassembled, the as-found fluid level is changed before the test is performed. For any snubber that is **NOT** scheduled for rebuild, the effects of the decontamination process should be thoroughly evaluated to determine whether the snubber should be disassembled to remove any fluid that might have entered. There should never be a need to disassemble a reservoir for decontamination. The vent hole in the reservoir of a gravity fed snubber is so small it should **NOT** allow contamination to enter, since it is always at the high point. Contamination usually falls instead of rising as it would have to do to infiltrate the reservoir.

7.17 Functional Test Program Guidelines

Any newly added, replacement, or refurbished snubber should be tested in accordance with the applicable functional testing Surveillance Instruction prior to installation. Once the functional test has been performed it remains acceptable for 1 year after completion, unless something happens or there is a concern about the snubber.

Functional tests are performed each operating cycle to meet Technical Requirements Manual TRM 3.7.4.2 verifying, by sampling 10% of each subgroup of snubber, that the safety-related or quality-related snubbers are operable. Fractional sample sizes shall be rounded up to the next integer. For each failure to meet the functional test acceptance criteria an additional 10% of the remaining snubbers in the subgroup shall be tested, until no additional failures occur. In addition to the required sampling, snubbers under service life monitoring and balance-of-plant programs should be addressed. Specific Technical Requirements are given in the appropriate functional testing SI.

For Unit 1, snubbers shall be tested in the as found condition regarding the parameters to be tested to the fullest extent practical. Test methods shall not alter the condition of a snubber to the extent the results do not represent the as found condition. Tests of snubbers shall be performed every fuel cycle. Tests of snubbers may begin no earlier than 60 days prior to a scheduled refueling outage.

When the required 100 percent visual exam is also to be performed for the operating cycle, it should be performed before the functional tests are performed. When the 100 percent visual exam is **NOT** required, a visual check of the snubber for indication of service-related degradation or damage of the snubber installation should be made before the snubber is disconnected or removed. This is a good preventative maintenance practice and **NOT** a SI visual examination requirement.

7.17 Functional Test Program Guidelines (continued)

7.17.1 Functional Test Packages

A. Test packages should be prepared for each individual snubber to be tested and should include the following:

1. Marked-up flow diagram to illustrate the snubber location in the system for Shift Manager/Unit Supervisor's review and approval.

2. Shift Manager/Unit Supervisor's authorization for snubber removal.

3. Configuration Control Drawing (CCD) or Design Change Authorization (DCA), approved for use by Site Engineering (Civil), depicting the current physical configuration.

4. Inservice Inspection (ISI) location drawing, if appropriate.

5. Notes of any special considerations such as scaffold or ladder requirements.

6. SI procedure, including data sheets.

7. Removal and Reinstallation procedure, including data sheets.

8. Calibration sheets for all M&TE used for this Work Implementing Document.

7.17.2 Functional Testing of PSA Mechanical Snubbers

A. BFN Technical Requirements require drag force measurements and activation verifications.

B. Mechanical snubber functional testing is performed to verify two characteristics, activation and drag force. The limit for acceleration is not to exceed 0.02 g's for the as left functional test and 0.04 g's for the as found functional test. Pacific Scientific Company (PSC) performed qualification tests on new snubbers and performed tests on snubbers that have been in extended plant service to verify the activation levels at various loads. PSC concluded that there is no significant change in activation value at any level of rated load of the snubber.

7.17.2 Functional Testing of PSA Mechanical Snubbers (continued)

C. Performing a test for activation of PSA snubbers requires a specialized test machine. BFN has a computer controlled API/Barker STB-200 snubber test bench. The test bench is capable of testing any size PSA snubber and most medium and small bore hydraulic snubbers. The software performs four basic functions:

1. Operator interface
2. Machine control
3. Data acquisition and conversion
4. Data analysis and presentation

Test results are presented in the form of a graph with maximum and average test values. The printout is easy to read and understand.

D. Visual Examination (VE)

Perform the VE according to the SI if the VE SI is scheduled for the current operating cycle. Otherwise, perform the visual check to determine overall integrity of the snubber.

7.17.2 Functional Testing of PSA Mechanical Snubbers (continued)

E. Activation Test

Activation test is performed using the test bench. Testing is performed in both directions (tension and compression). The acceptance criteria is equal to or less than 0.02 g's for as left functional test and 0.04 g's for as found functional test.

F. As-Found and As-Left Drag Force Test

Drag force is the minimum force required to initiate or maintain motion of the snubber. The drag force of any snubber should **NOT** over-stress the supported system/component. The snubber manufacturers recommended drag force value is 5% of the rated load for an NF mechanical snubber, except for the PSA-1/4.

This test is performed to verify the drag force of the snubber will **NOT** exceed 5% of the snubber rated load. An exception to this 5% of the rated load requirement is made when considering PSA 1/4 snubbers. In accordance with information from PSC, the PSA 1/4 snubber (Design Rated Load (DRL) - 350 lbs.) is evaluated to the same requirements as the PSA 1/2 (DRL - 650 lbs.) from a design load consideration. As determined by PSC, drag forces greater than 5% (except the PSA-1/4) is indicative of impending snubber failure.

If the drag force of the snubber is acceptable during the As-Found testing it may be used for the As-Left test results. For As-Found drag forces that exceed 3% but are less than 5%, the snubber shall be stroked several times in an attempt to redistribute the grease and reduce the drag.

The snubber shall then be retested for drag. If the drag force does **NOT** reduce to 3% or below, the snubber shall be replaced.

7.17.3 Functional Testing of Bergen-Paterson, Anchor/Darling, Fronek and Bergen-Paterson or Lisega Torus Dynamic Restraint Snubbers

The large size and difficult-to-remove snubbers, such as the Torus Dynamic Restraint snubbers, may be tested more economically in place, using machines designed for that purpose. The functional tests can be performed to determine lockup velocities, bleed rates, and seal integrity with the removal of only one pin. This functional testing will be performed by a contractor as BFN does **NOT** have a test machine with these capabilities. As with other snubbers this functional testing is performed in both the Extension (Tension) and Retraction (Compression) directions for lockup and bleed. Seal integrity is performed against the blind end and the rod end.

The smaller hydraulic snubbers are removed from the installed location, decontaminated, if necessary, and taken to the test bench for testing. As with other snubbers this functional testing is performed in both the Extension (Tension) and Retraction (Compression) directions for lockup and bleed. The computer controlled API/Barker STB-200 snubber test benches are capable of testing all Bergen-Paterson, Anchor/Darling, or Fronek hydraulic snubbers. The benches are easy to operate and the software is user friendly. The test results, i.e. lockup (activation) velocity, bleed (release) rate, and drag force are presented in the form of a graph with maximum and average test values. The printout is easy to read and understand. The graphs are to be placed with the SI functional test package and sent to the Electronic Document Management System (EMDS).

A. Visual Examination (VE)

B. Perform the VE according to the SI if the VE SI is scheduled for the current operating cycle. Otherwise, perform the visual check to determine overall integrity of the snubber. Lockup (activation) velocity and bleed rate should be in accordance with the acceptance requirements of the applicable functional test Surveillance Instruction.

   The drag force of any snubber should **NOT** over-stress the supported system/component. The snubber manufacturers factory or recommended drag force value is 2% of the rated load of an NF hydraulic snubber. That is taken as a screening value and larger values are evaluated on a case by case basis when found. Higher generic screening values might be obtained with piping system reanalysis or evaluation performed by Site Engineering (Civil).

C. Replacement of Torus Dynamic Restraint Snubbers

   If a Bergen-Paterson Torus Dynamic Restraint fails to pass its functional test acceptance criteria, the restraint shall be replaced with a new Lisega Torus Dynamic Restraint.

7.18 Rebuilding of Hydraulic Snubbers

Rebuilding of hydraulic snubbers shall be performed by task qualified and trained persons. Hydraulic snubbers shall be rebuilt in accordance with the following procedures, MPI-0-000-SNB001, and MPI-0-000-SNB002, Hydraulic Shock and Sway Arrestor Bergen-Paterson, Anchor/Darling, Fronek Unit Disassembly and Reassembly, as appropriate.

7.18.1 Hydraulic Rebuild Packages

A. Rebuild packages should be prepared for each individual snubber to be rebuilt and should include the following, as a minimum:

1. Removal and Reinstallation procedure, including data sheets.
2. Functional test SI procedure, including data sheets.
3. Appropriate rebuild procedure, including data sheets.
4. Shift Manager/Unit Supervisor's authorization for snubber removal.
5. Description, serial number, UNID, location history and the Work Implementing Document (WID) which removed the snubber, if the snubber was stored in the snubber test/rebuild facility.
6. Copy of the purchase contract, if the snubber was bought out of Nuclear Stores.
7. Completed ASME Section XI paperwork and NIS-2 forms.
8. Marked-up flow diagram to illustrate the snubber location in the system for Shift Manager/Unit Supervisor's review and approval.
9. Configuration Control Drawing (CCD) or Design Change Authorization (DCA), approved for use by Site Engineering (Civil), depicting the current physical configuration.
10. Inservice Inspection (ISI) location drawing, if appropriate.
11. Notes of any special considerations such as scaffold or ladder requirements.
12. SI procedure, including data sheets.
13. Removal and Reinstallation procedure, including data sheets.
14. Calibration sheets for all M&TE used for the WID.
15. PIC ticket for the seal kit, any new parts required and hydraulic fluid.

7.19 Evaluation of Degraded and Failed Snubbers

7.19.1 Degraded Snubbers

A. General Information

By the criteria established, degraded snubbers, are capable of performing their design basis function(s) and therefore have no effect on the system/component ability to perform its design basis function(s). (i.e., there are no Operability issues with degraded snubbers).

There are several items which can cause both mechanical and hydraulic snubbers to be in a degraded condition. These are as follows:

1. Cotter pins missing or installed but legs **NOT** sufficiently bent to prevent the pin from backing out.
2. Pivot pin retaining ring missing.
3. Security locking devices (i.e., locking tabs or wire) on the snubber attachment bolts missing, if required.
4. Spacers missing, leaving excessive gap on one side of the clevis.

When any of these conditions are found a Problem Evaluation Report (PER) should be written and the condition is to be corrected to prevent a more serious condition or cause a failure of the snubber in the future.

B. Mechanical Snubbers

Drag force is the only criteria which has a degraded category. The degraded category, for the drag force, is considered to be between 3% and 5% of the snubbers rated load.

1. If the snubber drag force is less than or equal to 3% of the snubbers rated load, the snubber may be reinstalled in its location without any further evaluation.
2. If the snubber drag force is above 3% but less than or equal to 5% of the snubbers rated load, the snubber shall be evaluated for impending failure.
3. If the snubber as found drag force is found to be above 5% of the snubber rated load, the snubber shall be declared as a functional failure and replaced. Also a Problem Evaluation Report (PER), an engineering failure analysis and a supported system/component analysis shall be completed.

7.19.1 Degraded Snubbers (continued)

C. Hydraulic Snubbers

The following conditions are considered as degradations for hydraulic snubbers:

1. Pits, scratches, or rough areas observed on the piston rod that would **NOT** contact the piston seals.
2. Fluid reservoir being below the minimum level, based on the temperature, but **NOT** empty.
3. Minor leaks which have **NOT** reduced the volume of the reservoir below the minimum required.
4. Minor rust or corrosion on the body of the snubber.

When any of these conditions are found a Problem Evaluation Report (PER) should be written and the condition corrected to prevent a more serious condition or cause a failure of the snubber in the future.

7.19.2 Failed Snubbers

A. General Information

1. Snubber Failure Classifications and Definitions:

   a. **Location** - A failure of a snubber(s) resulting from environmental conditions. Examples include failure of a snubber due to excessive heat, failure due to excessive local system vibration or failure due to other localized anomalies. (Application , Unit 1)

   b. **Manufacturing** - A failure resulting from a potential defect in manufacturing. Examples include incorrectly assembled snubbers, inclusion of incorrect piece parts and failure of a snubber(s) due to improper or incorrect maintenance or repair practices performed by the vendor. (Maintenance, Repair, or Installation , Unit 1)

   c. **Design** - A failure resulting from an error in the design. This classification would include incorrectly sized snubbers, snubbers provided with insufficient travel, snubbers with insufficient swing margins and design misapplications or errors.

   d. **Unknown** - A failure that cannot be categorized as location, manufacturing, design or other. This includes all failures for which the cause of failure cannot be determined.

   e. **Other** - When the unknown cause of the failure cannot be categorized as location, manufacturing or design. This classification would include snubbers that fail due to end of service life. Additional examples include failure of snubbers due to plant transients, misapplication of rigging loads to the snubber and incidental interaction of tools or equipment on the snubber. (Transient Dynamic Event, Unit 1)

2. A failed snubber is "GENERALLY" considered as **NOT** being able to perform the design basis function of the snubber. However, for the specific location even a failed snubber may be capable of performing its design basis function.

7.19.2 Failed Snubbers (continued)

3. If the failure was found as part of the Technical Requirements Manual initial or any subsequent samples the following is the minimum required testing expansion:

   a. Expand the sample by 10% of the remaining snubbers in the subgroup, and

   b. If the cause of the failure is determined to be a system transient, test all snubbers on that system, which could have been affected by the transient, and

   c. If the cause is a generic manufacturing defect, test all snubbers of that same type, and

   d. Identify and test all other snubbers suspected of the same failure mode.

4. If the failure was found outside of the Technical Requirements Manual initial or any subsequent samples (i.e., other maintenance activity, testing directed/requested by the Snubber Engineer, Service Life Monitoring testing, testing of snubbers on non-Technical Specification or Technical Requirements Manual systems, etc.) the following is the minimum required testing expansion:

   a. If the cause of the failure is determined to be a system transient, test all snubbers on that system, which could have been affected by the transient, and

   b. If the cause is a generic manufacturing defect, test all snubbers of that same type, and

   c. Identify and test all other snubbers suspected of the same failure mode.

7.19.2 Failed Snubbers (continued)

B. Failure Analysis

When a snubber fails to meet the functional test acceptance criteria, an engineering evaluation shall be made to determine the cause of the failure, as required by TSR 3.7.4.3. The results of this evaluation shall be used, if applicable, in selecting snubbers to be tested in an effort to determine the OPERABILITY of other snubbers irrespective of the type which may be subject to the same failure mode. This evaluation may also be used by Site Engineering (Civil) when they are required to perform a supported system/component analysis. For Unit 1 snubbers, the requirements of ISTD 5270 and ISTD 5500 shall also be fulfilled in the evaluation of failed snubbers.

During the failure analysis of hydraulic and mechanical snubbers, the performance should be very methodical.

Hydraulic snubbers typically fail because of loss of fluid, which results in no restraining action. This is referred to as failing soft. Some types of snubbers are prone to fail from a loss of bleed capability. This will be of affect only if the snubber has been activated. The failure analysis is to determine the reasons these conditions developed. Appendix H provides many very good points to be investigated during the analysis of hydraulic snubbers and their component parts, but this Appendix should **NOT** be viewed as all inclusive.

PSA mechanical snubbers typically fail from high drag forces that approach or are in the locked up condition. That condition requires a supported system/component analysis to determine the affect on the piping system or component from restriction of the thermal movement, in addition to the analysis to determine the cause of the high drag or locked up condition. Appendix I provides many very good points to be investigated during the analysis of mechanical snubbers and their component parts, but this Appendix should **NOT** be viewed as all inclusive.

C. Failure Cause Determination Techniques

Sometimes the cause of the inoperable condition can be determined by external examination, such as loose tubing connections or paint in the wrong places (i.e., on the moving parts). However, in most cases the snubber will require disassembly to determine what caused the condition. Visual examinations and measurements, coupled with the knowledge of what is required to keep the snubber operable are usually sufficient to determine what caused the condition. Sometimes additional knowledge is required to determine whether a part broke from an overload or fatigue, or broke in tension or compression, etc. Additional investigation is usually required to determine what caused the defect to develop. Such root causes may be improper maintenance, improper design or operation resulting in excessive vibration of the supported system/component.

7.20 Supported System/Component Analysis

7.20.1 Mechanical Snubbers

The drag force of the snubber should **NOT** overstress the supported system/component as a result of thermal expansion or contraction. The snubber manufacturer's recommended limiting drag force is 5% of the rated load of the snubber, except for the PSA-1/4. However, that value is applicable only to the functionality of the snubber. The structure, component, piping, or equipment that the snubber is supporting must be evaluated for high drag forces to ensure they have **NOT** been overstressed beyond their allowable limits. **REFER TO** General Construction Specification G-43 for screening values based on pipe size to determine when a supported system/component analysis is required.

7.20.2 Hydraulic Snubbers

The drag force of the snubber should **NOT** overstress the supported system/component as a result of thermal expansion or contraction. The snubber manufacturer's recommended limiting drag force is 2% of the rated load. However, that value is applicable only to the functionality of the snubber. The drag force of a hydraulic snubber will **NOT** overstress the pipe, but an analysis is required since the snubber failed its functional test acceptance criteria. General Engineering Specification G-43 gives screening values based on pipe size to determine when a supported system/component analysis is required. The G-43 values have **NOT** been accepted at Browns Ferry for hydraulic snubbers at this time.

A supported system/component analysis is required if the snubber failed the functional test acceptance criteria for activation and bleed.

7.21 Performance Monitoring and Trending

7.21.1 General Approach

The performance of snubbers is indicated by the results of the functional tests. The snubber tracking data base program is the primary means for tracking and trending of snubber performance. Some short term tracking is required by the Technical Requirements Manual relating to snubbers installed in the same location as other snubbers that failed during previous outage tests due to location or unknown causes. These snubbers are required to be tested during the next operating cycle if the failure was due to location or design deficiencies. Other manual tracking can be performed by referencing the functional test data sheets from previous outages; however, this tracking can be performed more efficiently if historical snubber tracking data base information is available.

When the same snubber has been tested several times, its results may be reviewed to determine whether a trend may be developing in the results. Appendix G provides additional guidance for the performance monitoring and trending of snubbers.

7.21.2 Trending for Hydraulic Snubbers

The test results that are significant for trending are the activation velocity and the bleed rate. Typically the snubber is rebuilt and as-left tests are performed to set the values in the optimum portion of the acceptance range. The results of the next as-found test should be compared to the last as-left test to determine any drift that has taken place. If the drift is consistent, the optimum setting might be changed to keep the as-found tests better in the acceptance range. If a snubber has **NOT** been rebuilt, the results of the next as-found test should be compared to the last as-found test to see if the acceptance range is degrading with the increased stay time.

7.21.3 Mechanical Snubber Performance Trending

A. Changes in drag force can take place for a number of reasons and there is no set pattern known to be specifically predictable. When high drag forces are caused by excessive or hardening lubricant, stroking the snubber can cause a redistribution of the lubricant, resulting in reducing the drag forces. The drag force may remain relatively low for a number of years when the lubricant is redistributed. Corrosion can be broken loose by stroking, but is usually progressive, and the drag force can be expected to increase again soon.

Snubbers are monitored for performance, with increasing drag forces taken as an indication of impending failure of the snubber. Snubbers previous test results should be reviewed to determine whether the trend is upward and some preventive maintenance is advisable to avoid the requirement of having drag forces above the screening criteria evaluated. Snubber drag forces between 3 to 5 percent of rated load should be evaluated for impending failures. The acceptance criteria for "as-left" drag forces is equal to or below 3% of the rated load for the snubber, with the exception of PSA 1/4 which use the acceptance criteria for PSA 1/2 snubbers. This practice is consistent with good industry practice to proactively replace PSA mechanical snubbers to reduce future test failures.

B. An upward trend in the drag force will effectively result in lowering the acceleration value, and there is no lower limit to the acceleration value. The concern with a locked up snubber is possible over stressing of the supported system/component under normal loading conditions. Some testing has indicated in some snubbers a slight upward trend in the acceleration value due to wear. Any performance monitoring of acceleration should be carefully evaluated using other plants and PSC test program results to determine its value.

7.22 Service Life Monitoring

7.22.1 Regulatory Requirements

The TR requires that the service life of hydraulic and mechanical snubbers be monitored to ensure that the service life is **NOT** exceeded between surveillance inspections. The object is to replace degraded components before they become inoperable. Service life varies with conditions and materials, and should be adjusted based on actual experience. Appendix G, of this procedure, provides additional guidance for a complete service life monitoring program.

7.22.2 Hydraulic Snubber Service Life Program

The static and dynamic seals, moving parts and fluid are subject to wear or other degradation. Hydraulic snubbers at Browns Ferry have ethylene propylene seals. The ethylene propylene seals at Browns Ferry have an established nominal service life of 17.3 years. Balance of plant hydraulic snubbers may be treated the same as safety-related snubbers for seal life extension.

The piston, piston rod, cylinder, and glands are also subject to wear, especially in high vibration installations. Those, and other moving parts of the snubber, should be examined carefully each time the seals are replaced, and replacements made to prevent leakage or other conditions of in-operability before the next time the snubber is to be rebuilt.

The fluid, if to be reused, should be checked at the rebuild time for moisture content and particulate content to determine whether it should be filtered to bring it within the specifications.

7.22.3 PSA Mechanical Snubber Service Life Monitoring

Drag force increase is NOT a reliable indicator of the remaining service life of the PSC snubber, but it is the best indicator identified to date. Therefore, service life effort involves tracking drag force variations.

7.23 Balance of Plant Hydraulic and Mechanical Snubbers

A. Snubbers installed in non-safety-related or non-quality-related applications are included in the Preventive Maintenance (PM) program for performance of visual examinations and functional tests on a basis subject to review and adjustment based on the results. Both hydraulic and mechanical snubbers will be included in the PM program.

B. Hydraulic snubber visual exams should be performed for fluid level and obvious problems frequently enough to assure the fluid level stays within the operability range. Snubbers should be examined for fluid level the next outage after they have been rebuilt, and the next exams scheduled based on the results and past experience. Balance of plant snubbers installed in similar environmental conditions as safety-related snubbers may be used to verify extension of seal life for the safety-related snubbers. Functional tests should be performed on a percentage and frequency based on the results of the safety-related snubber test results. A low failure rate would indicate an extended interval between tests and possibly a small sample would be appropriate.

C. The mechanical snubbers should be examined for signs of overload, abuse, and corrosion. The exams should be performed based on the environmental conditions and the activities performed in the area. A functional (activation or drag force) test or hand stroking, whichever is needed to confirm adequate freedom of movement, should be performed on suspect snubbers, and a sampling program should be considered.

7.24 Dynamic Transients

[1] In the event of a water hammer or an unanticipated transient, the following inspection and testing shall be performed to determine snubber operability. A Work Order (WO) is **NOT** required for a visual examination, but is required for performance of any functional testing or hand stroking required.

[1.1] **VISUALLY INSPECT** all snubbers and snubber supports that have been subjected to the transient. The visual inspection shall be performed in accordance with 1-SI-4.6.H-1, 2-SI-4.6.H-1, or 3-SI-4.6.H-1, as applicable.

[1.2] If the visual inspection reveals damage to the snubbers or to the snubber supports **MANUALLY STROKE** all mechanical snubbers, that have been subjected to the transient, to their full range of travel. Also **PERFORM** in-place drag force testing in accordance with 0-SI-4.6.H-2A.

[1.3] **IF** no visible damage to the snubber or snubber support is determined, **THEN**

MANUALLY STROKE 10% of the snubbers that have been subjected to the transient and **PERFORM** in-place drag force testing in accordance with 0-SI-4.6.H-2A.

[1.4] **IF** any snubber is found to be unacceptable **THEN**

an additional 10% of the snubbers, subjected to the transient, shall be tested until no failure is found or all snubbers, subjected to the transient, have been tested.

[1.5] **PERFORM** a failure analysis for each failed snubber to determine failure mode.

[1.6] Testing of hydraulic snubbers is **NOT** required since internal damage to the hydraulic snubber in **NOT** likely to occur.

7.25 Snubber Users Group (SNUG)

7.25.1 SNUG Organization Formation and Purpose

SNUG was formed in the winter of 1984 as an information sharing group which addresses industry snubber concerns including maintenance, regulation, and surveillance. SNUG does **NOT** formally address licensing concerns and vendors will **NOT** be allowed membership. The only membership requirements are that a utility must actively participate in the SNUG data base information exchange and a small fee, as designated by the Board of Directors. Each utility is requested also to select two designees at each plant and/or utility as primary and secondary contacts. Further information concerning SNUG may be found in the SNUG "By-Laws" and "Policy Statements".

7.26 Snubber Program Notebook

The snubber program notebook contains the program description, future refueling outage schedule, trend data, results of recent snubber inspections, program health reports, industry operating experience, hard to find snubber information, and a log of recent program challenges or issues. Appendix L is an example of the suggested format.

Procedures and other controlled documents do not need to be included, but should be specifically referenced, in the snubber program notebook.

8.0 ACCEPTANCE CRITERIA

Each unit acceptance criteria shall be In accordance with the applicable and appropriate Maintenance and Surveillance Instructions that is approved by NRC for each unit Request for Relief.

9.0 APPENDICES

9.0 APPENDICES (continued)

Appendix A
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Snubber Request for Relief 3-ISI-2

This relief request was approved by the NRC. Refer to 3-SI-4.6.G for details related to this request.

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Bergen-Paterson, Anchor/Darling or Fronek Hydraulic Snubber

1.0 GENERAL DESCRIPTION

Hydraulic snubbers consist basically of a main cylinder, main piston, fluid modulating (control valve) device and fluid makeup reservoir. Under normal operating conditions, when piping and equipment moves thermally at relatively low velocities, fluid passes from one end of the main cylinder to the other through the control valves with little or no resistance. Under dynamic conditions, at relatively high velocities, the fluid is "choked" (snubber lock up) or blocked at the control valve, allowing little or no further motion of the main piston rod other than that due to compression of the fluid and metallic parts.

BFN purchased its original snubbers from Bergen-Paterson and they were purchased as Safety-Related, NF. The Bergen-Paterson Part Numbering was primarily used which reflects the rating in KIPS of each snubber. These snubbers were manufactured in lots and **NOT** given an individual serial number, therefore Browns Ferry developed an individual serial number and stamped this number on the snubber body. This numbering system has been the means of tracking these snubbers as they have been moved from location to location.

In 1978 Bergen-Paterson revised their numbering system to the following:

2500	-	XXX	-	XXX
Model No.		Kip Rating		Sequential Unit No.

Later the numbering system was changed by Anchor/Darling to the following:

ADH	-	XXX	-	XXX
		Model No.		Sequential Unit No.

Fronek has retained the Anchor/Darling numbering system.

The Bergen-Paterson, Anchor/Darling and Fronek snubbers are located in all three units.

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2.0 TYPES AND SIZES FOR THE BERGEN-PATERSON, ANCHOR/DARLING AND FRONEK HYDRAULIC SNUBBERS:

- HSSA-3, 3 Kips, 6 inch stroke (Bergen-Paterson part number HSSA-3 or 2500-3)
- HSSA-10, 10 Kips, 6 inch stroke (Bergen-Paterson part number HSSA-10 or 2500-10)
- HSSA-20, 20 Kips, 6 inch stroke (Bergen-Paterson part number HSSA-20 or 2500-20)
- HSSA-30, 30 Kips, 6 inch stroke (Bergen-Paterson part number HSSA-30 or 2500-30)
- ADH-3, 3 Kips, 6 inch stroke (Anchor/Darling part number ADH-300)
- ADH-10, 10 Kips, 6 inch stroke (Anchor/Darling part number ADH-1000)
- ADH-20, 20 Kips, 6 inch stroke (Anchor/Darling part number ADH-2000)
- ADH-30, 30 Kips, 6 inch stroke (Anchor/Darling part number ADH-3000)
- ADH-50, 50 Kips, 6 inch stroke (Anchor/Darling part number ADH-5000)
- ADH-70, 70 Kips, 6 inch stroke (Anchor/Darling part number ADH-7000)
- ADH-120, 120 Kips, 6 inch stroke (Anchor/Darling part number ADH-12000)
- ADH-130, 130 Kips, 6 inch stroke (Anchor/Darling part number ADH-13000)

3.0 TEST PARAMETERS IN THE SNUBBER TEST MACHINE PROGRAM:

The following parameters shall be verified to work on the test machine, with the associated snubbers, and the accompanying plot shall be located as close to the center of the graph as possible. If the plot does **NOT** show in the center of the graph the following parameters may be changed to center the plot and give the best looking plot available.

- <u>Valve Open</u> - This value is in percent of command output. If the operator wishes to start the valve sooner the percent value may be reduced, which will require the valve to open sooner causing the command ramp to "jump" up to an initial value and overcome the dead band.

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3.0 TEST PARAMETERS IN THE SNUBBER TEST MACHINE PROGRAM: (continued)

- Valve End - The valve end value allows the operator to set an endpoint for the proportional valve opening at less than 100 percent full open. If the operator wishes the profile to extend or reduce this value should be increased or decreased, as necessary. This value must be controlled enough so the snubber will lockup and bleed, prior to the end of the test. This value controls the ramp profile in the activation tests.

- Ramp Duration - This value sets the time duration of the ramp between valve start and valve end. This value may be decreased, which moves the plot to the left on the graph. In the acceleration tests this value is limited to .45 sec maximum.

- Load Duration - This is the time that the valve will remain at the valve end position, after the ramp time has elapsed. Adjusting this value "up" will assure that the complete test will show on the graph.

TYPE	HSSA 3	HSSA 10	HSSA 20	HSSA 30
KIP RATING	3	10	20	30
STROKE	6	6	6	6
ACTIVATION RATE	10	10	10	10
RELEASE RATE	2	2	2	2
ACCELERATION RATE	N/A	N/A	N/A	N/A
DRAG FORCE RATE	2	2	2	2
TEST LOAD	80	80	80	80
PRESSURE BOOST	100	100	100	100
VALVE START	7	8	8	8
VALVE END	15	25	25	25
DRAG SPEED	2	2	2	2
RAMP DURATION	7.0	9.5	9.5	9.5
LOAD DURATION	2.9	.4	.4	.4
BENCH (B)IG/ (S)MALL	S	B	B	B

TYPE	ADH/FRONEK 20	ADH/FRONEK 30	ADH/FRONEK 50	ADH/FRONEK 70	ADH/FRONEK 130
KIP RATING	20	30	50	70	130
STROKE	6	6	6	6	6
ACTIVATION RATE	10	10	10	10	10
RELEASE RATE	2	2	2	2	2
ACCELERATION RATE	N/A	N/A	N/A	N/A	N/A
DRAG FORCE RATE	2	2	2	2	2
TEST LOAD	80	80	80	80	80
PRESSURE BOOST	100	100	100	100	100
VALVE START	8	8	8	8	8
VALVE END	25	25	25	25	25
DRAG SPEED	2	2	2	2	2
RAMP DURATION	9.5	9.5	9.5	9.5	9.5
LOAD DURATION	.4	.4	.4	.4	.4
BENCH (B)IG/ (S)MALL	B	B	B	B	B

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4.0 POPPET TYPE CONTROL VALVES

Most snubber designs use spring loaded poppet (flow sensitive check) valves to limit the velocity of the piston rod. The lockup is controlled by the size of the flats on the head of the poppet and bleed rate is controlled by small grooves cut in the bottom portion (seating area) of the poppet. The spring is calibrated to keep the poppet valve from closing on its seat until the fluid velocity past the poppet head provides enough force on the poppet to overcome the spring and close the poppet. These valves are **NOT** adjustable and the poppet or spring are required to be replaced to achieve the desired lockup or bleed rate. When the cylinder has a single ended piston rod and the flow rate from the front and rear of the piston will be different for the same piston velocity, different size poppet heads are used to close at approximately the same piston velocity in either direction of travel. The small flow also prevents a solid lock-up of the valve and potential difficulty in the relief of pressure on the valve.

If for some reason the grooves become clogged the snubber would remain a rigid strut until enough time elapsed to allow the snubber to depressurize. This could cause serious damage to the piping or equipment if thermal movements were required to take place immediately after a dynamic event.

5.0 RESERVOIRS

Hydraulic snubbers usually require a fluid reservoir for the following reasons:

- to provide makeup fluid for the volume displaced by the piston rod in single ended piston rod models.
- to compensate for thermal expansion and contraction of the fluid.
- to provide a fluid reserve in the event of low level fluid loss such as that due to normal rod wetting during stroking.

This type of snubber contains a pressurized, external (integral) reservoir.

These pressurized reservoirs are isolated from the atmosphere by a plunger attached to a piston. This type of reservoir is less prone to the intrusion of moisture, but they do have one fault. That is the reservoir plunger penetration does **NOT** have a seal and if the snubber is **NOT** oriented properly water can penetrate into the atmospheric side of the reservoir and deteriorate the piston and seals causing total fluid loss from the reservoir.

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6.0 HYDRAULIC SNUBBER FLUIDS

6.1 General Requirements

The fluid used in snubbers should be fire resistant, radiation resistant, have a flat viscosity curve, and be compatible with seal materials such as ethylene propylene.

The silicon fluid used at BFN is General Electric (GE) SF-1154. This fluid is expensive and should be reused when practical. The fluid should **NOT** get contaminated since it is used under pressure in these snubbers. Partially used container should be closed with an air tight cap to prevent moisture from entering the container. If open to the atmosphere this fluid is extremely prone to the absorption of moisture.

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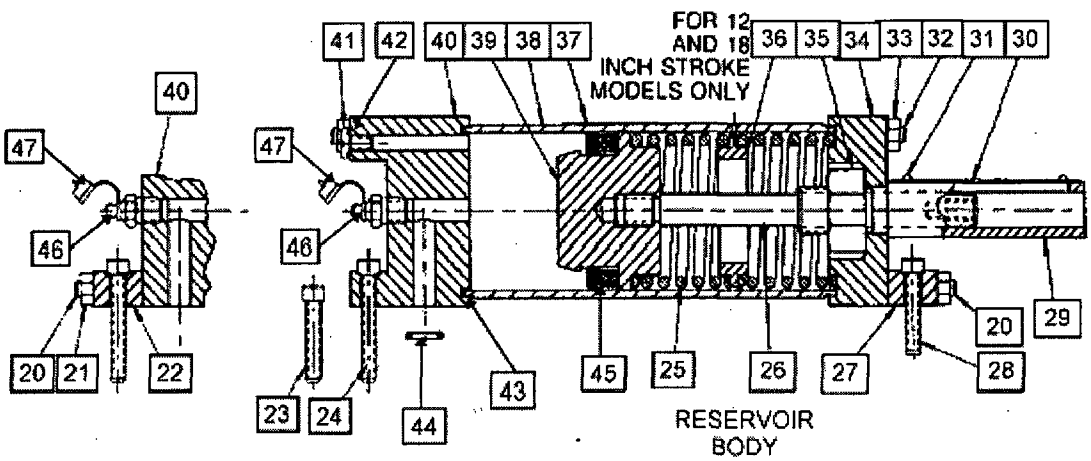
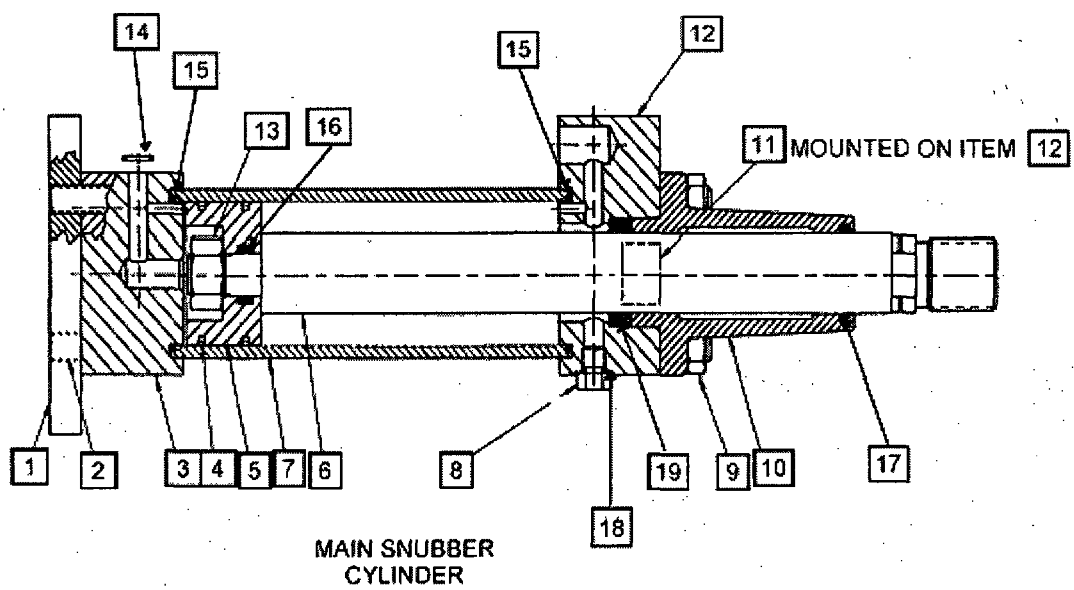
7.0 BERGEN-PATERSON, ANCHOR/DARLING OR FRONEK HYDRAULIC HARDWARE AND SOFTWARE PARTS NUMBERS AND PARTS LIST





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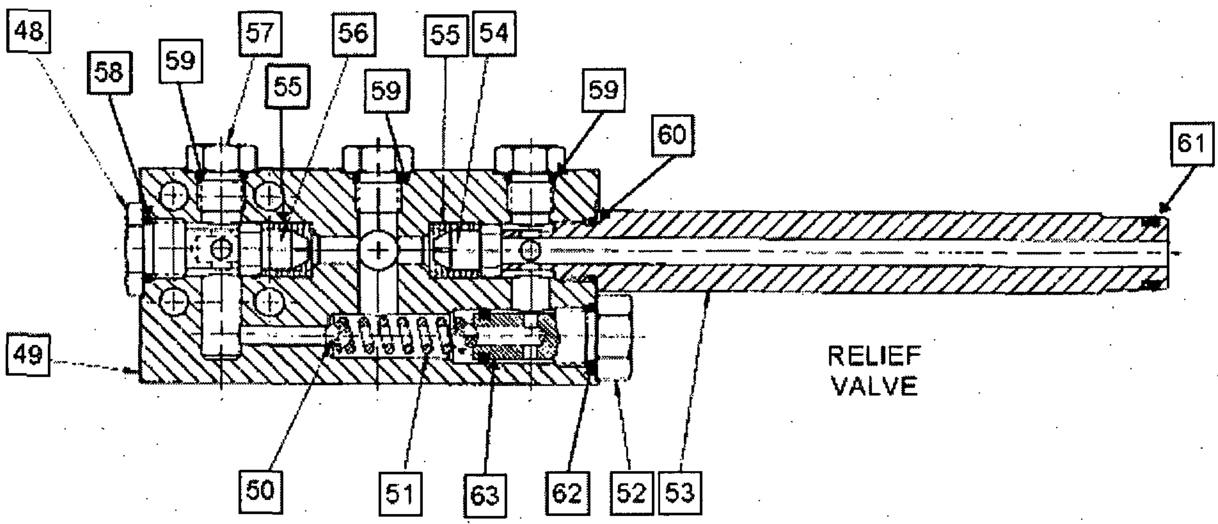
7.0 BERGEN-PATERSON, ANCHOR/DARLING OR FRONEK HYDRAULIC HARDWARE AND SOFTWARE PARTS NUMBERS AND PARTS LIST (continued)



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7.0 BERGEN-PATERSON, ANCHOR/DARLING OR FRONEK HYDRAULIC HARDWARE AND SOFTWARE PARTS NUMBERS AND PARTS LIST (continued)

ITEM NO.	DESCRIPTION
1	MOUNTING FLANGE
2	TIE ROD
3	CAP
4	PISTON RING
5	PISTON
6	CYLINDER TUBE
7	PISTON ROD
8	FLUSH PLUG-PORT PLUG
9	TIE ROD NUT
10	GLAND
11	NAME PLATE
12	HEAD
13	PISTON ROD NUT
14	VALVE TO MAIN BODY'O' RING
15	CAP OR HEAD TO CYL.'O' RING
16	PISTON TO ROD'O' RING
17	MAIN PISTON ROD WIPER
18	FLUSH PLUG-PORT PLUG'O' RING
19	PISTON ROD PACKING SEAL
20	RESERVOIR TIE ROD - LONG
21	RESERVOIR TIE ROD NUT
22	RESERVOIR REAR MOUNTING LUG
23	VALVE BODY MOUNTING SCREW
24	RESERVOIR REAR MOUNT SCREW
25	RESERVOIR SPRING
26	RESERVOIR TAIL ROD
27	RESERVOIR FRONT MOUNT LUG
28	RESERV FRONT MOUNT SCREW
29	RESERV INDICATOR PROT TUBE
30	RESERV LEVEL INDICATOR PLATE
31	NAME PLATE DRIVE SCREW
32	RESERVOIR TIE ROD - SHORT

ITEM NO.	DESCRIPTION
33	RESERVOIR TIE ROD NUT
34	RESERVOIR HEAD
35	RESERVOIR INDICATOR TUBE LOCK NUT
36	RESERVOIR SPRING GUIDE
37	RESERVOIR WARNING TAG
38	RESERVOIR CYLINDER TUBE
39	RESERVOIR PISTON
40	RESERVOIR CAP
41	RESERVOIR SEAL SCREW
42	RESERVOIR SEAL SCREW'O' RING
43	RESERVOIR CAP OR HEAD TO CYL.'O' RING
44	VALVE TO RESERV'O' RING
45	RESERVOIR PISTON ROD PACK
46	RESERVOIR FILLER PLUG
47	RESERVOIR FILL PLUG COVER
48	POPPET STOP AND PLUG
49	FLOW CONTROL BODY
50	RELIEF VALVE BALL
51	RELIEF VALVE SPRING
52	RELIEF VALVE PLUG
53	CONNECTOR TUBE
54	EXTENSION POPPET
55	POPPET SPRING
56	COMPRESSION POPPET
57	SAE PORT PLUG
58	POPPET STOP & PLUG'O' RING
59	SAE PORT PLUG'O' RING
60	CONNECTOR TUBE'O' RING
61	CONN TUBE - HEAD'O' RING
62	RELIEF VALVE PLUG'O' RING
63	RELIEF VALVE'O' RING

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Bergen-Paterson Torus Dynamic Hydraulic Restraint Snubbers

1.0 GENERAL DESCRIPTION

There are sixteen Torus Dynamic Restraints installed on each Torus and are located at 22-1/2 degree intervals around the exterior radius of the Torus.

All of the restraints are dimensionally and functionally identical and can be installed at any location.

All of the restraints are identified by individual serial numbers to serve as a specific identification for each restraint during manufacture, initial testing, and future recording purposes.

These restraints effectively restrain forces in both tension and compression, along an axis of 45 degrees from the horizontal, in the radial direction from the centerline of the reactor.

The restraints have a service life of 40 years and no service life monitoring program will be required for these restraints.

The Torus Dynamic Restraints consist of a 12 inch bore, internally ported hydraulic, cylinder having a poppet valve assembly located in recesses machined in the blind and rod end heads.

The valve controlling movement in the extension direction is located in the rod end head (nearest the Torus) and the valve controlling movement in the retraction direction is located in the blind end head (nearest the wall).

The poppet valve has grooves which allow a small amount of fluid to pass the poppet after the activation velocity, of between 6 and 25 inches per minute, has been exceeded and the poppet has closed.

A spring loaded pressurized fluid accumulator is mounted on flat machined surfaces on the upper portion of the circular surface of the blind end and rod end heads. The hydraulic system is maintained under pressure to maintain a minimum required 6300 kips/in spring constant.

The restraint has a total stroke length of 1-1/2 inches.

The rod end paddle of the restraint is pinned to a clevis bracket welded to each ring girder above the PSC ring header support.

The blind end paddle is pinned to a clevis bracket mounted on the wall.

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1.0 GENERAL DESCRIPTION (continued)

The original pins are 4 inch diameter and have a slight interference fit between the clevis eye and the spherical bushing on the restraint.

When the restraints are removed for functional testing, a new two piece pin is installed in the place of the shrink fit pin to enhance the removal and reinstallation of the restraints in the future.

All of the Bergen-Paterson Torus Dynamic Restraints are accessible during reactor operation and form a single group because they are identical in design. They are a group separate from other Bergen-Paterson snubbers because of the seal, valve design and size.

The restraints are designed to reduce the dynamic response of the Torus to excitation caused by a design base LOCA.

The principal specification governing performance of the restraints is the 7000 kip/inch minimum dynamic spring rate.

The restraints have a maximum rated load of 200 KIPS in tension and 230 KIPS in compression.

2.0 OPERABILITY REQUIREMENTS AND MAINTENANCE RECOMMENDATIONS (CEB'84 0503 015)

This information defines operability requirements for the Bergen-Paterson Torus Dynamic Restraint Snubbers and provides related maintenance recommendations.

2.1 General Operability Requirements

Torus Restraint Snubber (TRS) operability is of concern for conditions requiring primary containment integrity and for which a significant potential for a Loss of Coolant Accident (LOCA) exists. Those conditions exist when the reactor is in the operating, hot standby, or hot shutdown mode, as defined by the BFN Technical Specifications. They do **NOT** exist in the refueling or cold shutdown mode.

To be considered operable, a TRS must be installed and maintained in accordance with all applicable TVA design drawings and BP instruction manuals. In addition, the snubber reservoir fluid level must be maintained such that an acceptable axial spring rate is provided.

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2.2 Effect of Inoperability

The TRS function is to reduce dynamic motion of a Torus and its attachments (structures and piping) during postulated LOCA events. They also limit Torus motion during normal safety/relief valve discharges and postulated seismic events but are **NOT** required for plant safety under those conditions.

Each TRS restrains 1 of the 16 ring girders on a Torus. Its region of significant influence is within the two Torus bays adjacent to that ring girder. Each TRS basically functions independently during a postulated LOCA event.

If one TRS was inoperable during a LOCA, the applicable code allowable stress for the Torus and attachments in the adjacent bays could be exceeded. If two or more snubbers were inoperable, proportionately larger regions of the Torus would be similarly affected. Maximum dynamic response would occur in a Torus bay if the snubbers for both adjacent ring girders were inoperable. Under such conditions, the affected Torus and attachment regions would be substantially degraded, relative to satisfying code allowable stresses, but still capable of withstanding the most probable design basis accident, intermediate break accident, and small break accident LOCA loads without loss of containment integrity.

2.3 Recommended Fluid Level Limits for Disk Spring Reservoirs

2.3.1 Applicability

These limits are applicable during operating cycle 6 and later cycles of each unit when the reactor is in the operating, hot standby, or hot shutdown mode.

2.3.2 Limits (both must be satisfied)

A. Maximum d = 1.595 - 0.01483 (100 - T)

B. Minimum d = 0.904 + 0.01561 (T - L)

where:

d = Distance from end of indicator rod to face of reservoir at temperature T (inches).

T = Snubber temperature when d is measured (°F).

L = Minimum snubber temperature for the time period of concern (°F).

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NOTES
1) The reservoir is full when d = 3.118 inches and it is 1/5 full when D = 0.904 inch.
2) L may be conservatively set at 50 °F. Less conservative values of L are also permissible if justified by in-plant temperature data. L may **NOT** be greater than T.
3) No maximum d limit is defined in consideration of the over pressure relief feature of the disc spring reservoirs.

2.3.3 Basis for limits

These limits ensure a minimum spring rate of 6300 kips per inch for all anticipated snubber temperatures, including an upper limit of 100 °F. They are based upon approved BP test and design documentation for the TRS assemblies. An EN DES calculation CD-Q0010-890191 (CEB 840330 012) documents their deviation.

2.4 Recommended TRS Maintenance Policies for each BFN Unit

2.4.1 Operability of a leaking TRS

A leaking TRS shall be declared inoperable if reservoir filling to maintain acceptable fluid levels is required at time intervals of 3 hours or less.

A leaking TRS may be electively declared inoperable if another TRS or the drywell/wetwell differential pressure system is **NOT** already inoperable.

The 3 hour time limit is based upon a 20 minute LOCA dynamic load duration with no reservoir filling during the event. Note that a TRS will **NOT** become inoperable due to air ingestion during operation as long as the fluid reservoir remains pressurized to levels ensured by the specified level limits. The restrictions on electively declaring inoperability are based upon minimizing the probability for maximum Torus response during postulated LOCA events.

2.4.2 Exceeding Fluid Reservoir Limits

If a TRS reservoir fluid level is found outside the limits specified in this section at snubber temperature T and with L = T, the TRS shall be declared inoperable until the fluid level is restored to an acceptable value.

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2.4.3 Exceeding Temperature Limits

If a TRS temperature is found outside the range from 50°F to 100°F, Site Engineering (Civil) shall be notified and an operability determination shall be made within 72 hours.

This position is based upon the anticipated normal range of TRS fluid temperatures and the TRS design temperature range. Torus room ambient air temperatures outside this range would indicate a very unusual occurrence. Note that insignificant increases in TRS fluid temperatures are predicted during LOCA dynamic events.

2.4.4 Engineering Evaluations

An engineering evaluation shall be performed for each instance in which a TRS is determined to be inoperable. Site Engineering (Civil) shall provide assistance upon request and shall be informed of the evaluation results.

2.4.5 Functionality Testing

Functionality tests are **NOT** necessary on a routine basis or as a result of anticipated cases of TRS inoperability. It is possible, but **NOT** probable, that limited functionality tests may be required for extreme cases of inoperability. That determination must be made by the required engineering evaluations on a case-by case basis.

This position is based upon the extensive qualification tests and functionality tests performed by BP. It is also based upon performing installation and maintenance in strict compliance with approved procedures.

2.5 References Concerning Operability of the Torus Restraint Snubbers

A. H. J. Green's Memorandum to M. N. Sprouse dated March 15,1983 (DES 830316 019)

B. M. N. Sprouse's Memorandum to H. J. Green dated April 4, 1983 (MEB 830404 006)

C. Bergen-Paterson Pipesupport Corp. Memorandum to TVA (Gil Payne) dated March 29, 1983 (MEB 830330 526)

D. G. L. Payne Note to R. O. Barnett dated April 1, 1984 (MEB 830401 028)

E. R. O. Barnett Memorandum to G. R. Hall dated April 12, 1984 (CEB 830412 015)

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2.5 References Concerning Operability of the Torus Restraint Snubbers (continued)

F. Bergen-Paterson Pipesupport Corp. Memorandum to TVA (Mr. C. A. Chandley) dated July 25, 1983 (MEB 830728 503)

G. Bergen-Paterson Pipesupport Corp. Memorandum to TVA (Mr. C. A. Chandley) dated September 7, 1983 (MEB 830909 525)

H. R. O. Barnett Note to J. K. Rochelle dated September 12 1984 (MEB 830912 021)

I. Bergen-Paterson Pipesupport Corp. Memorandum to TVA (Mr. C. A. Chandley) dated March 7, 1984 (MEB 840313 502)

J. R. O. Barnett Note to J. K. Rochelle dated March 15,1984 (MEB 840316 010)

K. E. H. New Memorandum to C. A. Chandley dated January 12, 1984 (MEB 840116 507)

L. C. A. Chandley Memorandum to E. H. New dated February 8, 1984 (MEB 840208 019)

M. E. H. New Memorandum to C. A. Chandley dated February 27, 1984 (LOO 840228 191)

N. C. A. Chandley Memorandum to E. H. New dated March 12, 1984 (MEB 840312 016)

O. G. T. Jones Memorandum to P. R. Wallace dated March 13, 1984 (L52 840313 809)

P. J. A. Coffey's Memorandum to R. W. Cantrell dated March 21, 1984 (L22 840321 800)

Q. Calculation for Fluid Level Limits for Torus Restraint Snubbers (CEB 840330 012)

R. W. S. Wilburn's Memorandum to G. T. Jones dated April 6, 1984 (L22 840406 801)

S. R. W. Cantrell's Memorandum to J. A. Coffey dated April 11, 1984 (MEB 840411 009)

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2.5 References Concerning Operability of the Torus Restraint Snubbers (continued)

T. R. W. Cantrell's Memorandum to J. A. Coffey dated May 3, 1984 (CEB 840503 015)

U. J. P. Darling Memorandum to R. W. Cantrell dated May 4, 1984 (L22 840504 800)

V. Gil Payne's Memorandum to Mechanical Engineering Support Branch Files dated May 31, 1984 (MEB 840531 008)

W. J. P. Darling's Memorandum to R. W. Cantrell dated June 21, 1984 (L22 840618 800)

X. Bergen-Paterson Pipesupport Corp. Memorandum to TVA (Mr. H. E. Crisler) dated May 8, 1986 (B22 860512 001)

Y. H. B. Bounds' Memorandum to G.G. Campbell dated November 25, 1988 (B22 881123 305)

Z. D. C. Mims' Memorandum to J. W. Hutton dated July 25, 1989 (R20 890725 999)

AA. Torus Integrity Long - Term Program, Plant Unique Analysis Report (CEB 841210 008)

BB. Technical Operability Evaluation 2-96-064-0834 (R40 960715 950)

CC. Engineering Work Request 98-3-064-071 (R21 980921 003)

DD. Technical Operability Evaluation 2-99-064-11704 dated October 18, 1999

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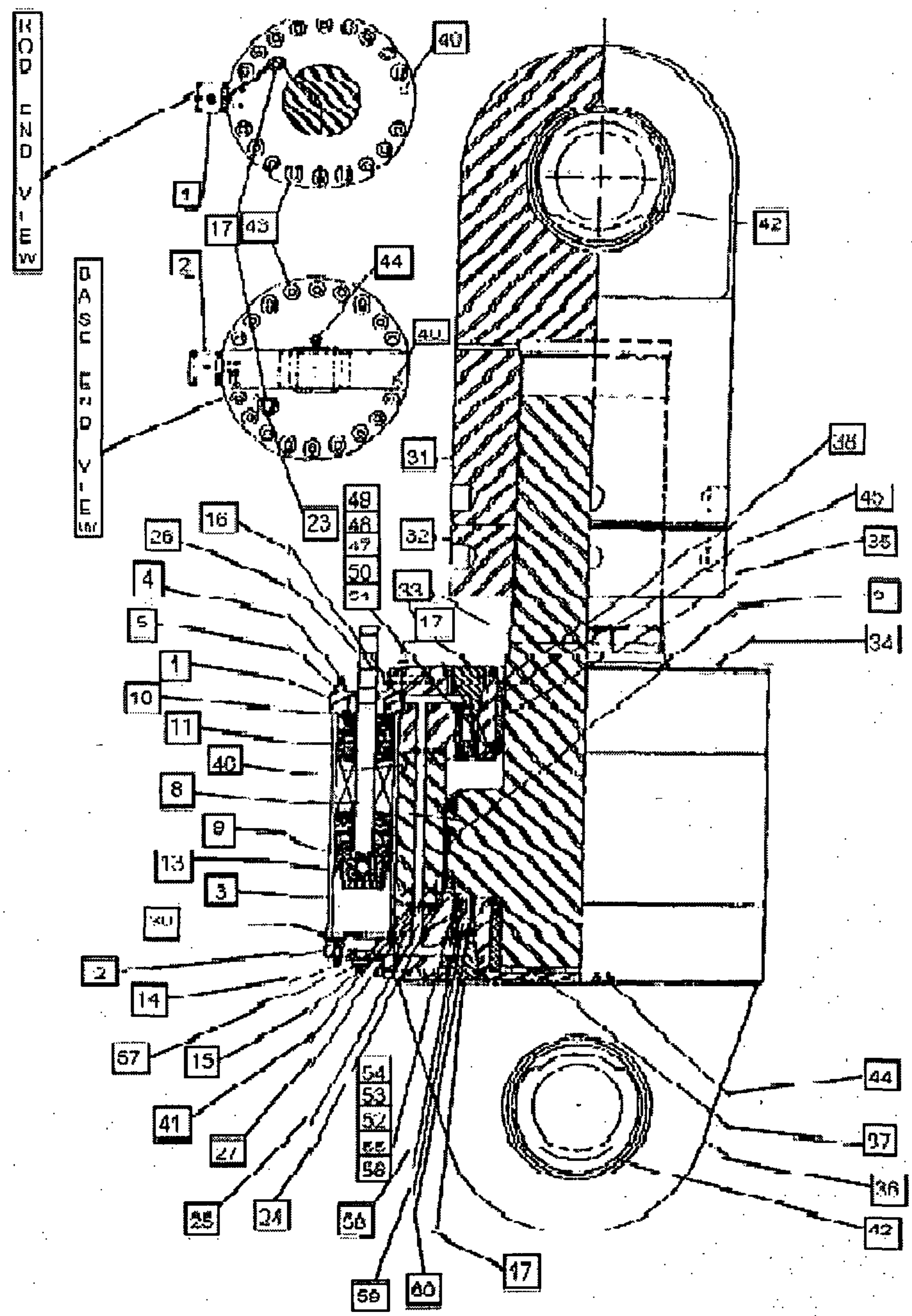
3.0 BERGEN-PATERSON TORUS DYNAMIC RESTRAINT HARDWARE AND SOFTWARE PARTS NUMBERS AND PARTS LIST



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3.0 BERGEN-PATERSON TORUS DYNAMIC RESTRAINT HARDWARE AND SOFTWARE PARTS NUMBERS AND PARTS LIST (continued)

ITEM NO	DESCRIPTION	ITEM NO	DESCRIPTION
1	RESERVOIR HEAD	31	ROD EYE
2	RESERVOIR CAP	32	LOCK NUT
3	RESERVOIR TUBE	33	MAIN PISTON ROD
4	TIE RODS	34	MAIN CYL. ROD HEAD
5	TIE ROD NUTS	35	ROD HEAD GLAND BUSHING
6		36	MAIN CYL. BASE HEAD
7		37	BASE HEAD GLAND BUSHING
8	INDICATOR ROD	38	ROD HEAD BUSHING RET. RING
9	RESERVOIR PISTON	39	MAIN PISTON RIDER
10	RESERVOIR SPRING SPACER	40	LOCATOR PIN
11	BELLEVILLE SPRING	41	MAIN CYL. BARREL TUBE
12		42	BALL BUSHINGS
13	RESERVOIR PISTON PACKING	43	CAP SCREWS
14	RESERVOIR BLEEDER	44	BASE HEAD BREATHER
15	FILLER FITTING	45	ROD WIPER
16	CAP SCREWS	46	TUBE BLEEDERS
17	VALVE BLOCK	47	ROD SEAL ENERGIZERS
18		48	ROD SEAL V - PACKING
19		49	ROD SEAL BACK - UP RING
20		50	ROD SEAL WAVE SPRING
21		51	ROS SEAL RETAINING RING
22		52	PISTON SEAL ENERGIZERS
23	CAP SCREWS	53	PISTON SEAL V - PACKING
24	CYL. TUBE/HEAD INNER RING	54	PISTON SEAL BACK - UP RING
25	CYL. TUBE/HEAD OUTER RING	55	PISTON SEAL WAVE SPRING
26	RESERVOIR TO HEAD	56	PISTON SEAL RETAINING RING
27	HEAD TO TUBE MANIFOLD	57	ALUMINUM SPACER RING
28		58	POPPET STOP
29		59	POPPET
30	RESERVOIR SEAL	60	POPPET SPRING

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Lisega Torus Dynamic Restraint Hydraulic Snubbers

1.0 GENERAL DESCRIPTION

The mode of operation of these hydraulic shock absorber rests on the fact that, except for a minimal friction, no resistance is offered to a slow movement of the connected components.

Under undesirable, shock-type movements resulting from unplanned load conditions the shock absorber locks and forms momentarily an almost rigid connection. The dynamic forces occurring as a result are absorbed and conducted harmlessly into the structural connection. At the reduction of the pressure wave to almost 0, the locking terminates and a possible simultaneous temperature movement is no longer inhibited.

During reversal of direction of movement caused by counter-oscillation or renewed impulse, the mode of operation takes place in the reverse direction. It can change infinitely within the frame of complex oscillation spectrums. The response reaction of these shock absorbers lies in a frequency band of 0.5-100 Hz.

During slow movement of the piston (≤ 4.72 in/min.), spring pressure keeps the valve open, allowing the hydraulic fluid to flow from one side of the piston to the other.

During fast movement of the piston (≥ 4.72 in/min. approx.), fluid flow pressure on the valve plate closes the main valve. The flow of hydraulic fluid is stopped and the movement of the piston is restricted. The compressibility of the fluid has a softening effect on the restriction of the piston. As fluid is compressed by the piston, the movement is arrested elastically. As a result, damaging load spikes are avoided.

As the load subsides, the pressure on the closed valve is reduced. When the force of the spring is greater than the compression force of the fluid, the valve opens.

To eliminate any possibility of the valve remaining closed, it is fitted with a by-pass bleed system. This allows a very limited movement of the piston under load, and ensures quick equalization of pressure between the cylinder chambers when the load is removed.

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1.0 GENERAL DESCRIPTION (continued)

The position of the main piston within the cylinder can be instantly read by checking the concentric scale rings machined into the piston rod. The sturdy stainless steel shroud protecting the piston rod also duals as a position indicator.

In order to maintain the functional performance of the snubber, sufficient hydraulic fluid must be maintained within the unit. The reservoir has a rod attached to the reservoir piston that protrudes from the reservoir. Markings to indicate the fluid level in the unit are scribed onto the rod. Inspection of this indicator eliminates the necessity for dismantling the snubber cylinder to determine the fluid level.

2.0 CONTROL VALVES

The control valves are placed in the body of the shock absorber on opposite ends of the cylinder. They are aligned to the reservoir, and work directly with the volume compensator.

In order to facilitate scheduled maintenance, the control valves can be removed while the snubber remains in place. Previously qualified and tested valves can be installed immediately and the snubber returned to service. The original valves can then be remotely tested using a surrogate snubber on a standard snubber test bench.

3.0 RESERVOIR

In order to accommodate increased fluid volume compensation requirements, the reservoir cylinder is positioned parallel to the working cylinder to avoid disproportionate dimension and weights. The reservoir is sealed against the atmosphere by a spring-loaded piston. While sealing the reservoir, the piston also generates a small amount of pressure within the system. This positive pressure energizes the seals in the snubber, increases their effectiveness and prevents ingestion of air.

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4.0 HYDRAULIC SNUBBER FLUIDS

4.1 General Requirements

The fluid in the snubbers should be fire resistant, radiation resistant, have a flat viscosity curve, and be compatible with seal materials such as Viton.

The silicon fluid used at BFN for these snubbers is Silicone AP 280 furnished by LISEGA. This fluid is expensive and should be reused when practical. The fluid should **NOT** get contaminated since it is used under pressure in these snubbers. Partially used containers should be closed with air tight cap to prevent moisture from entering the container.

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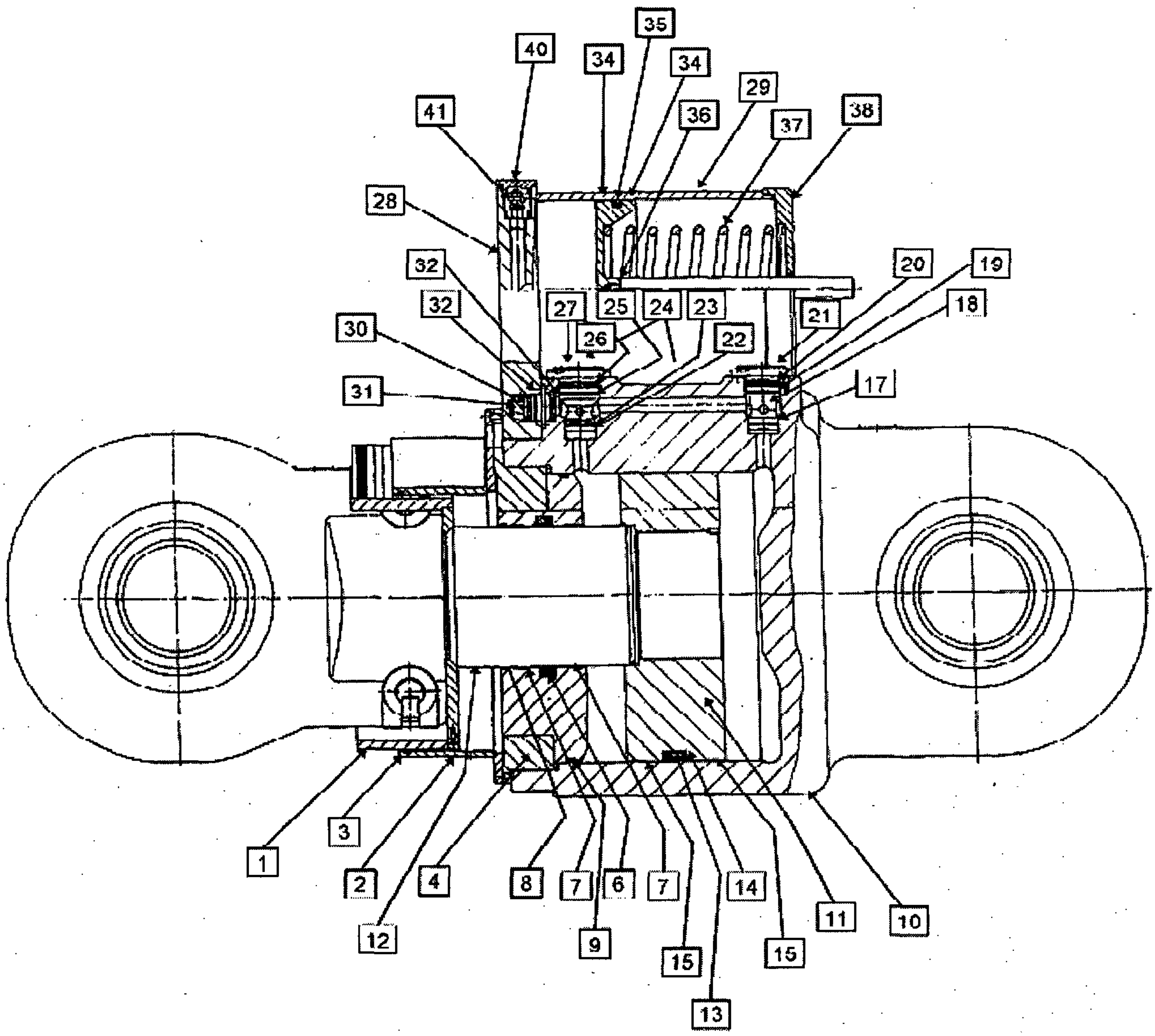
5.0 LISEGA TORUS DYNAMIC RESTRAINT HARDWARE AND SOFTWARE PARTS NUMBERS AND PARTS LIST



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5.0 LISEGA TORUS DYNAMIC RESTRAINT HARDWARE AND SOFTWARE PARTS NUMBERS AND PARTS LIST (continued)

ITEM NO.	DESCRIPTION	ITEM NO.	DESCRIPTION
1	TRAVEL INDICATOR TUBE	22	FRONT VALVE SEAT CIRCLIP
2	PROTECTIVE TUBE	23	FRONT LOWER VALVE “O”RING
3	PROTECTIVE TUBE WIPER RING	24	FRONT VALVE
4	THREADED RING (Upper Cylinder)	25	FRONT UPPER VALVE “O”RING
5	CYLINDER BODY LID (Upper Cylinder)	26	FRONT VALVE LID “O”RING
6	COMPLETE ROD SEALING SET	27	FRONT VALVE LID
7	GUIDE BAND	28	RESERVOIR BOTTOM
8	PISTON ROD COMPACT SEAL	29	RESERVOIR TUBE
9	CYLINDER DOUBLE WHIPER RING	30	CLOSING PISTON
10	MAIN CYLINDER BODY	31	CLOSING PISTON SPRING
11	MAIN CYLINDER PISTON	32	CLOSING PISTON “O”RING
12	MAIN CYLINDER PISTON ROD	33	RESERVOIR PISTON
13	PISTON “O”RING	34	RESERVOIR PISTON GUIDE BAND
14	PISTON SEAL SET	35	RESERVOIR PISTON V-PACKING RING
15	GUIDE BAND	36	RESERVOIR PISTON ROD CIRCLIP
16	REAR VALVE SEAT CIRCLIP	37	RESERVOIR SPRING
17	REAR LOWER VALVE “O”RING	38	RESERVOIR LID
18	REAR VALVE	39	RESERVOIR FLUID INDICATOR ROD
19	REAR UPPER VALVE “O”RING	40	RESERVOIR FLUID FILL CAP
20	REAR VALVE LID “O”RING	41	RESERVOIR DEAERATING VALVE
21	REAR VALVE LID		

Appendix E

Pacific Scientific Company Mechanical Snubbers

1.0 DESCRIPTION, DESIGN AND OPERATION OF MECHANICAL SNUBBERS

1.1 General Description

Mechanical snubbers are manufactured by Pacific Scientific Company and are designated as PSA. Mechanical snubbers have dual failure modes in that they may either fail to activate or may "freeze" or lockup, becoming a rigid restraint.

The PSA snubber is acceleration limiting, and is effective in a seismic event because the motion is cyclic in a frequency range of 3 to 33 Hertz. PSA snubbers operate on the principle of limiting acceleration values of any pipe movement to a threshold level of 0.02 g's (7.7 in/sec squared). This is the maximum acceleration that the snubber will permit, and a breaking force will be applied within the snubber of whatever magnitude is required to limit the acceleration to a value less than 0.02 g's. At the same time, thermal expansion, being a gradual movement, is **NOT** restricted. A particular feature of mechanical snubbers is that at no time does it lock and become a rigid strut. When sudden acceleration occurs and is sustained continuously in one direction, the snubber will apply necessary force to limit the pipe movement to its preset threshold value. The snubber's performance is independent of the amount of force being applied (provided the force is less than the rated load).

BFN requirements for PSA mechanical snubbers is to determine that resistance to rapid increased in velocity takes place and the maximum acceleration limit is 0.04 g's for the "as-found" acceptance criteria with no specified lower limit. Based on the review of a study made by A.T. Onesto, the design organization determined that an acceleration value up to 0.04 g's is acceptable for protection of the piping systems. (Refer to source reference O pg. 9 of this procedure). PSA factory acceptance of 0.02 g's is based on limiting the lost motion in the snubber, and that value was typically adopted in the industry as the operability acceptable criteria. The value of 0.02 g's has been adopted as the "as-left" acceptance criteria.

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1.1 General Description (continued)

BFN purchased all of its PSA snubbers through Bergen-Paterson, therefore, the Bergen-Paterson Part Numbering was primarily used which reflects the rating in KIPS of each snubber. Additionally, a majority of the PSA snubbers were purchased Safety-Related, NF. The PSA Part Numbers differ from the Bergen-Paterson because the snubbers were originally qualified Pre-NF, and given Part Numbers in accordance with that KIP rating. When the same components were re-qualified under NF, their KIP ratings increased but PSA never changed Part Numbers. Only a few PSA-10 snubbers were purchased as Pre-NF. These snubbers are located in all three units and are painted white to distinguish them from the NF snubbers. The Pre-NF snubbers are rated at 10 Kips while the NF snubbers are rated at 15 Kips. They are located on the Main Steam Relief Valve (MSRV) Tail Pipes. When the Pre-NF, 10 Kip, snubbers are replaced in Unit 2, they will be replaced with NF snubbers rated at 15 Kips, by changing the end plug and the rear attachment from the Pre-NF to the new NF snubber. All Pre-NF snubbers have been removed from all units at BFNP.

1.2 Pacific Scientific Mechanical Snubber (PSA-1/4 AND PSA-1/2) Design and Operation

Following is a description of the design and method of operation of the three versions of the PSA snubbers. Some details of the internal mechanism are different, depending on the capacity of the snubber, but the principle of operation is essentially the same.

Figure 1 shows a cross section representing PSA-1/4 and PSA-1/2 snubbers. Also, Figure 2 shows the part numbers of the snubbers.

The snubber consists essentially of an inertia mass containing a clutch spring, a torque carrier and screw shaft assembly which also contains a capstan spring, a rod and bearing assembly, an inner tube, an anti-rotation key, a housing and a telescoping outer tube.

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1.2 Pacific Scientific Mechanical Snubber (PSA-1/4 AND PSA-1/2) Design and Operation (continued)

The rod and bearing assembly consists of a spherical bearing, end plug, two connecting rods and a helical cam bearing. The helical cam bearing end of the rod and bearing assembly engages the screw shaft of the torque carrier and shaft assembly. The shaft mounts the inertia mass, inside which is installed the clutch spring. The tangs of the capstan spring installed in the torque carrier are positioned between the lips of the clutch spring installed in the inertia mass. In this manner, the torque carrier is coupled to the inertia mass. The housing is secured by a retaining ring to the flange on the end of the inner tube. The housing shields the internal parts of the arrestor and prevents contaminants from entering. The restricting function of the snubber is primarily accomplished by changing the relative linear motion, of the telescoping inner and outer tubes of the snubber, into rotary motion of the torque carrier and the inertia mass. Figure 1 shows the snubber almost fully retracted. As the snubber is extended, the outer cylinder attached to the spherical bearing end, slides over the inner cylinder which is attached to the housing. The nut is attached to the spherical bearing end by the two rods. As the nut moves with the spherical bearing and, it forces the shaft screw to turn which makes the torque carrier spin, since they have a press fit.

The capstan spring rotates with the torque carrier, and the tangs of the capstan spring also drive the inertia mass through engagement with the up-turned ends of the clutch spring. If the speed of the torque carrier is changed, the speed of the inertia mass must also change since they are connected by the tangs of the capstan spring.

If the speed change is made suddenly, the inertia mass, by tending to stay at its existing speed, will overcome the capstan spring resistance and close it down on the end of the inner cylinder which is stationary in the housing. The spring in contact with the inner cylinder acts as a brake and slows the change in speed of the torque carrier as it is driven by the nut moving, as the snubber is extended. The same type of action takes place as the snubber is retracted. By this action the snubber limits the rate of velocity change or acceleration.

Vibrations cause rapid changes in direction and velocity which activate the snubber by causing the capstan spring to close down on the end of the inner cylinder.

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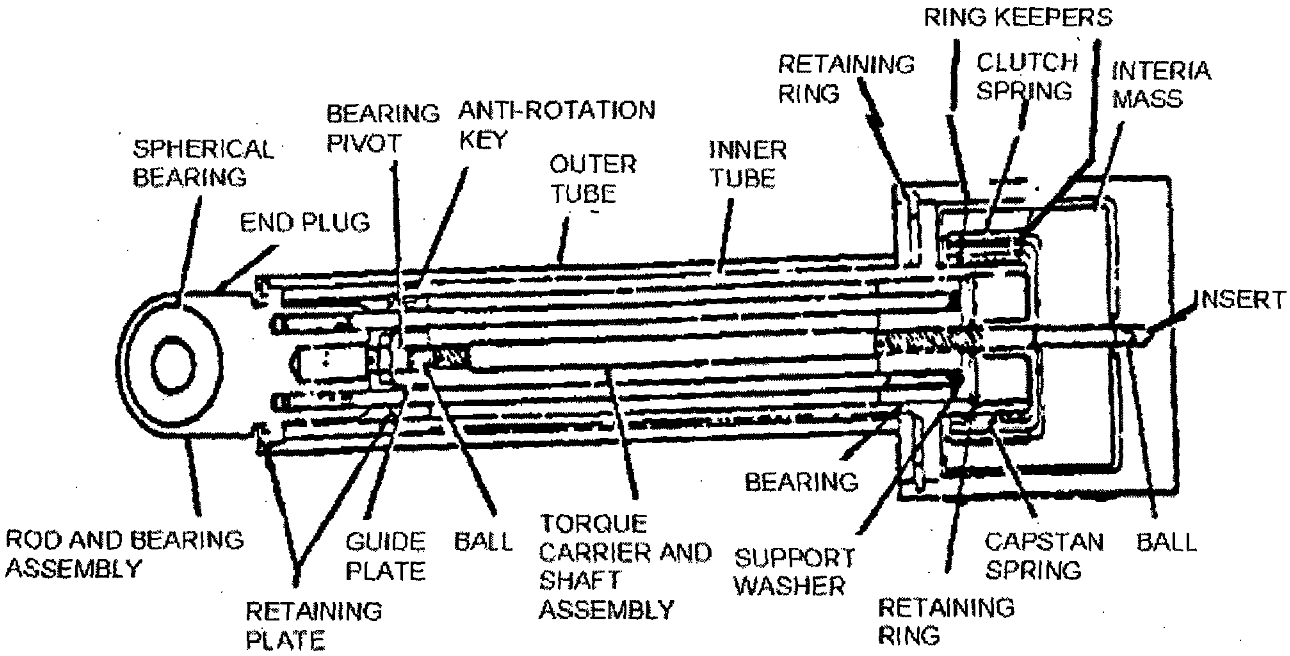
2.0 PSA-1/4 AND PSA-1/2 CROSSSECTION, HARDWARE PARTS NUMBERS AND HARDWARE PARTS LIST



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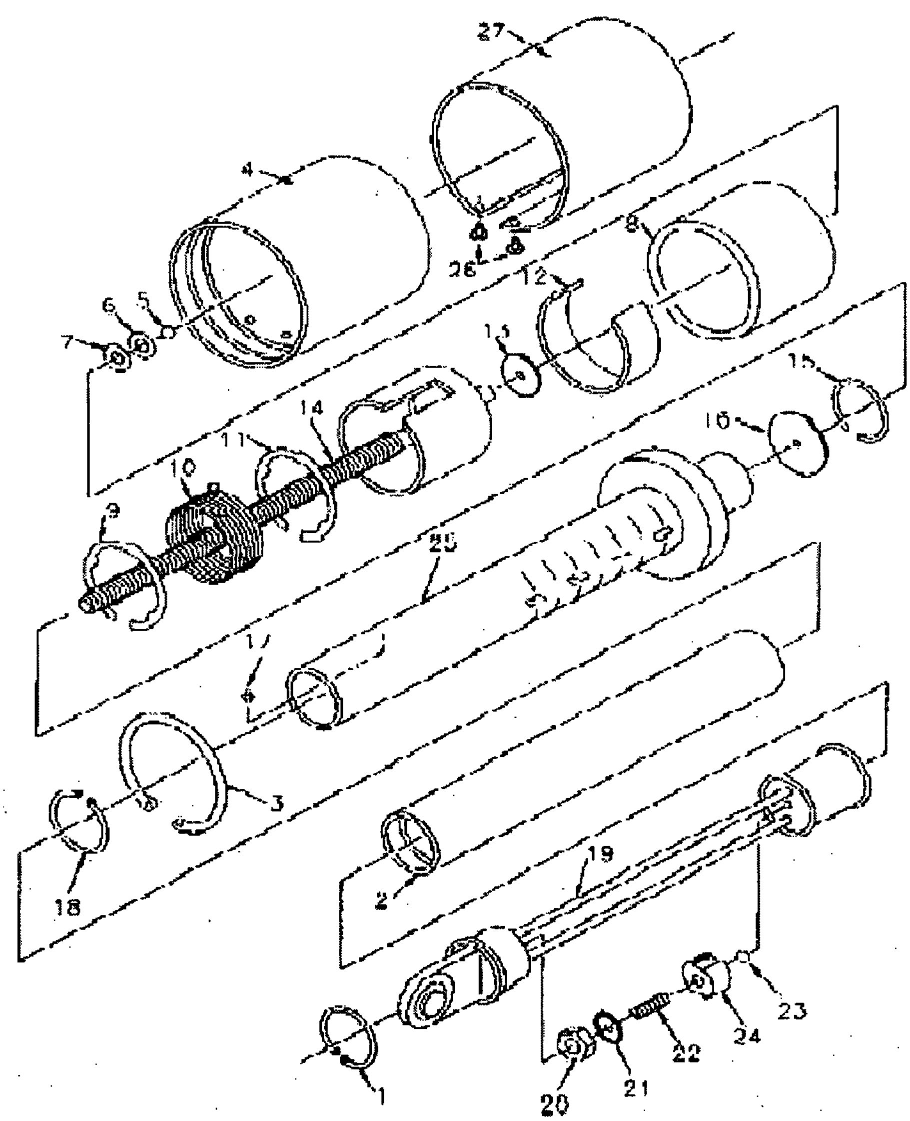
2.0 PSA-1/4 AND PSA-1/2 CROSSSECTION, HARDWARE PARTS NUMBERS AND HARDWARE PARTS LIST (continued)



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2.0 PSA-1/4 AND PSA-1/2 CROSSSECTION, HARDWARE PARTS NUMBERS AND HARDWARE PARTS LIST (continued)

FIG & INDEX NO.	PART NO.	DESCRIPTION	USABLE ON CODE
	1801104-05	ARRESTOR, MECHANICAL SHOCK, MODEL PSA-1/4	A
	1801104-07	ARRESTOR, MECHANICAL SHOCK, MODEL PSA-1/2	B
1	0911100-89	RING, RETAINING	A,B
2	1801247-01	TUBE, OUTER	A
	1801247-03	TUBE, OUTER	B
3	0911100-90	RING, RETAINING	A,B
4	1801900-01	HOUSING AND INSERT ASSEMBLY	A,B
5	1801367-01	BALL	A,B
6	0903100-36	WASHER	A,B
7	0903100-37	WASHER	A,B
8	1801241-01	INTERIA MASS	A,B
9	1801537-01	RING, KEEPER	A,B
10	1801612-01	SPRING, CAPSTAN	A,B
11	1801537-01	RING, KEEPER	A,B
12	1801305-01	SPRING, CLUTCH	A,B
13	0903100-50	WASHER, FLAT	A,B
14	1801861-01	CARRIER AND SHAFT ASSEMBLY, TORQUE	A
	1801862-01	CARRIER AND SHAFT ASSEMBLY, TORQUE	B
15	0911100-91	RING, RETAINER	A,B
16	1801306-01	WASHER, SUPPORT	A,B
17	1801303-01	KEY, ANTI-ROTATION	A,B
18	0911100-08	RING, RETAINING	A,B
19	1801533-01	ROD AND BEARING ASSEMBLY	A
	1801533-03	ROD AND BEARING ASSEMBLY	B
20	NAS671-8	NUT, JAM	A,B
21	MS35335-31	WASHER, LOCK	A,B
22	1801311-01	BEARING, PIVOT	A,B
23	1801367-01	BALL	A,B
24	1801252-01	GUIDE PLATE	A,B
25	1801250-01	TUBE, INNER	A
	1801250-03	TUBE, INNER	B
26	AN535-2-2	SCREW, DRIVE	A,B
27	1801301-01	NAMEPLATE	A,B

2.1 Pacific Scientific Mechanical Snubber (PSA-1, PSA-3 AND PSA-10) Design and Operation

Figure 3 is a cross section that represents the PSA-1, PSA-3, and PSA-10 snubbers. Also, Figure 4 shows the part numbers of the snubbers.

The snubbers consists of a support cylinder, an inertia mass containing a clutch spring, a torque transfer drum containing a capstan spring, an end plug assembly, a position indicator tube, and a housing. The support cylinder contains a telescoping cylinder, and anti-rotation key, and a ball bearing screw assembly. The telescoping cylinder and recirculating ball nut and screw assembly are the main design concept difference from the PSA-1/4 and PSA-1/2.

The ball screw is supported by the traveling recirculating ball nut and by a ball bearing assembly near one end. The recirculating ball nut is staked to and travels with the telescoping cylinder, as do the end plug assembly and the position indicator tube. The ball screw shaft extends through the thrust bearing fitted into the bore of the support cylinder. The ball screw shaft mounts through the torque drum and inertia mass and is keyed to the torque drum and the inner race of the thrust bearing. The inertia mass is free to rotate on the end of the ball screw shaft. The tangs of the capstan spring installed in the torque drum extend through a slot in the torque drum and are located between the up-turned ends of the clutch spring installed in the inertia mass. This couples the torque drum to the inertia mass. The housing is attached by a retaining ring to a flange at the capstan end of the support cylinder. The housing and a dust cover shield the internal parts of the arrestor and prevent contaminants from entering. The restraining function of the PSA-1, -3, and -10 snubbers is accomplished by translating linear motion of the telescoping cylinder, within the support cylinder, into rotary motion of the torque drum and the inertia mass. As the snubber is extended or retracted, the telescoping cylinder moves inside the support cylinder. The recirculating ball nut is fixed to the telescoping cylinder, and the telescoping cylinder is prevented from rotating by the anti-rotation key attached to the stationary support cylinder. Therefore, as the recirculating ball nut is moved in or out with the telescoping cylinder, the ball screw is forced to rotate, and the torque drum spins with it. The tangs of the capstan spring drive the inertia mass, and if the speed is changed gradually, the spring does **NOT** tighten down on the end of the support cylinder. If the speed changes suddenly, either slowing down or increasing, the inertia mass displaces the tangs of the capstan spring and closes the spring down on the end of the support cylinder, acting as a brake. The arresting action of the snubber is essentially the same as for the PSA-1/4 and PSA-1/2.

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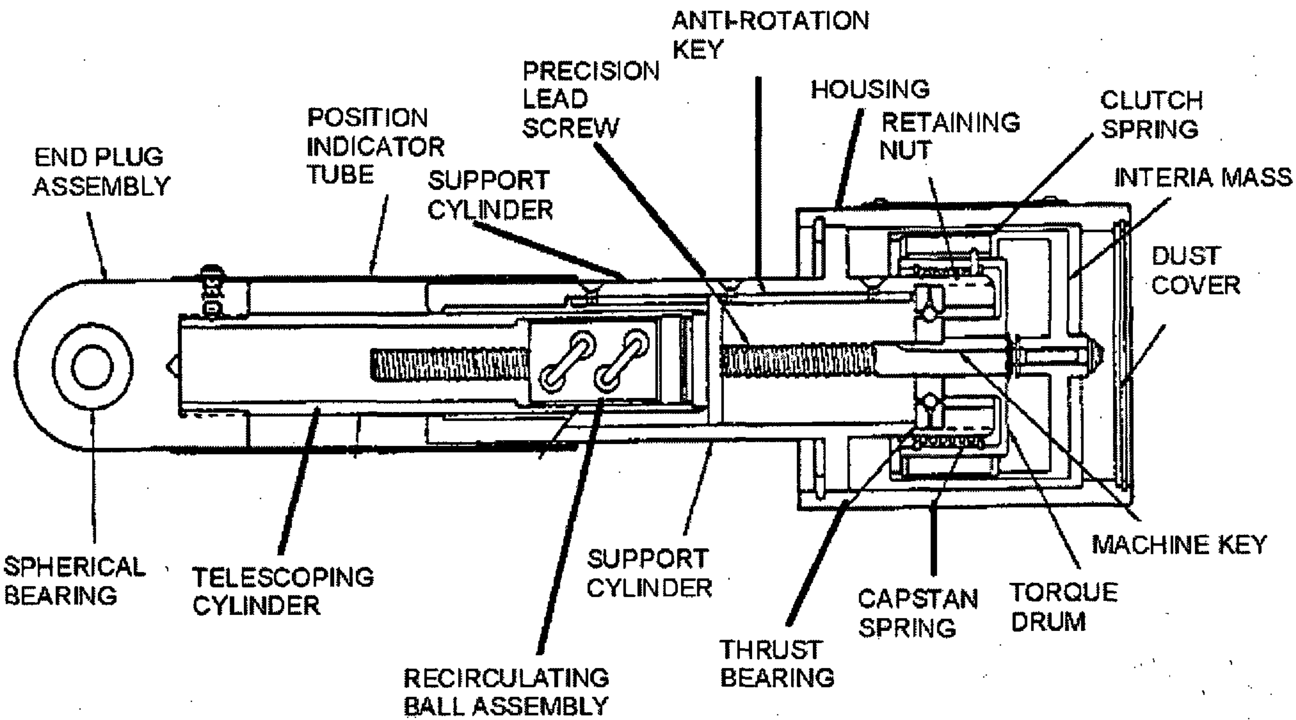
3.0 PSA-1, PSA-3 AND PSA-10 CROSSSECTION, HARDWARE PARTS NUMBERS AND HARDWARE PARTS LIST



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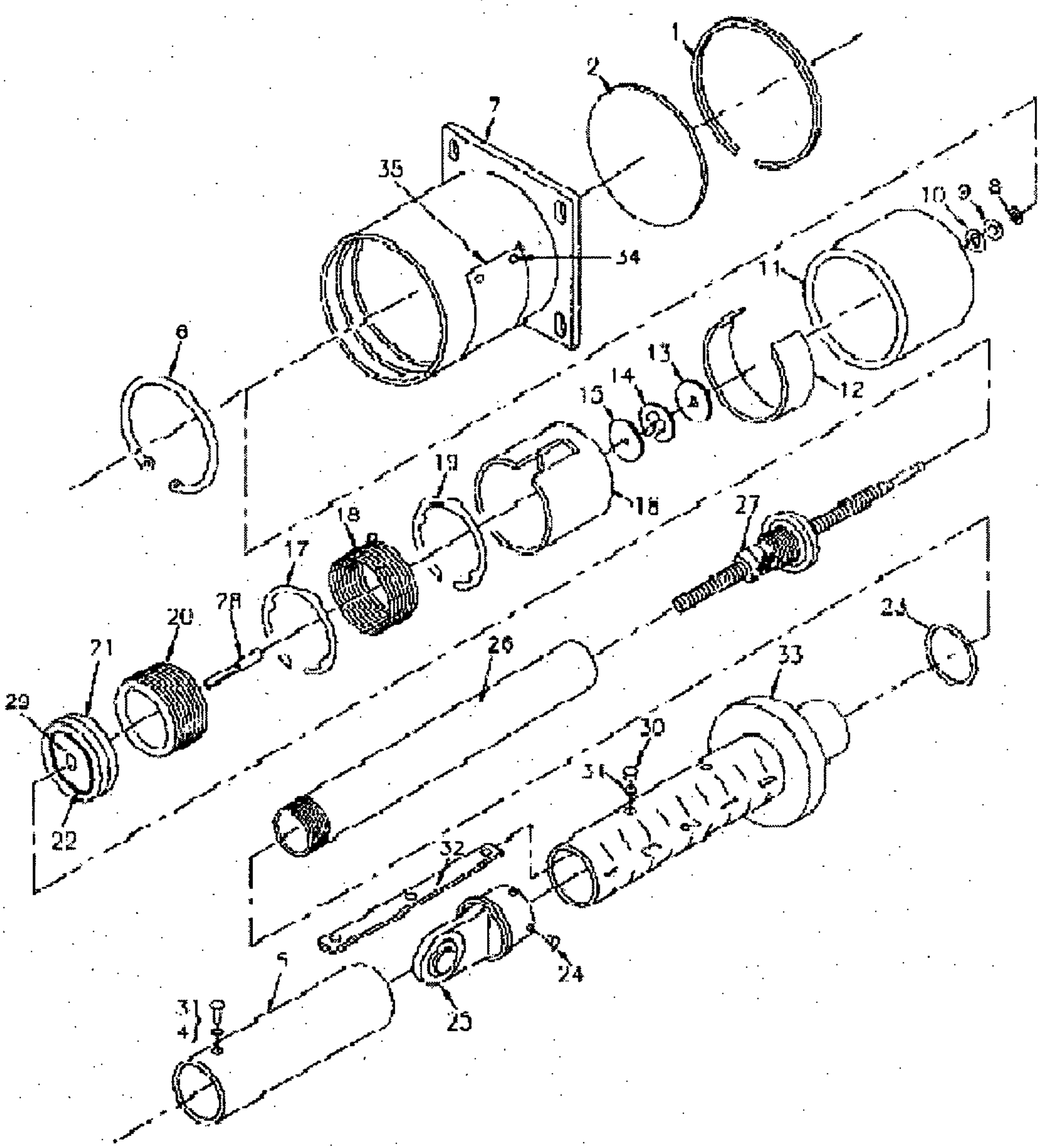
3.0 PSA-1, PSA-3 AND PSA-10 CROSSSECTION, HARDWARE PARTS NUMBERS AND HARDWARE PARTS LIST (continued)



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3.0 PSA-1, PSA-3 AND PSA-10 CROSSSECTION, HARDWARE PARTS NUMBERS AND HARDWARE PARTS LIST (continued)

FIG & INDEX NO.	PART NO.	DESCRIPTION	USABLE ON CODE
	1801102-05	ARRESTOR, MECHANICAL SHOCK, MODEL PSA-1	A
	1801106-05	ARRESTOR, MECHANICAL SHOCK, MODEL PSA-3	B
	1801103-07	ARRESTOR, MECHANICAL SHOCK, MODEL PSA-10	C
1	0911100-84	RING, RETAINING	A
	0911100-80	RING, RETAINING	B
	0911100-96	RING, RETAINING	C
2	1801232-01	COVER, DUST	A
	1801260-01	COVER, DUST	B
	1801217-01	COVER, DUST	C
3	AN503-8-4	SCREW, FILLISTER HEAD	A
	AN501A10-4	SCREW, FILLISTER HEAD	B
	AN501A10-5	SCREW, FILLISTER HEAD	C
4	AN960-8	WAHSER, FLAT	A
	AN960-10L	WASHER, FLAT	B,C
5	1801238-05	TUBE, POSITION INDICATOR	A
	1801267-05	TUBE, POSITION INDICATOR	B
	1801216-05	TUBE, POSITION INDICATOR	C
6	0911100-98	RING, RETAINING	A
	0911100-81	RING, RETAINING	B
	0911100-97	RING, RETAINING	C
7	1801281-05	HOUSING	A
	1801274-05	HOUSING	B
	1801360-07	HOUSING	C
8	0911100-111	RING, RETAINING	A
	0911100-110	RING, RETAINING	B
	0911100-109	RING, RETAINING	C
9	0903100-41	WASHER, FLAT	A
	0903100-33	WASHER, FLAT	B
	0903100-39	WASHER, FLAT	C
10	0903100-23	WASHER, FLAT	A
	0903100-33	WASHER, FLAT	B
	0903100-38	WASHER, FLAT	C
11	1801224-03	INERTIA MASS	A
	1801276-01	INERTIA MASS	B

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3.0 PSA-1, PSA-3 AND PSA-10 CROSSSECTION, HARDWARE PARTS NUMBERS AND HARDWARE PARTS LIST (continued)

FIG & INDEX NO.	PART NO.	DESCRIPTION	USABLE ON CODE
	1801205-01	INTERIA MASS	C
12	1801288-01	SPRING, CLUTCH	A
	1801272-01	SPRING, CLUTCH	B
	1801201-01	SPRING, CLUTCH	C
13	0903100-41	WASHER, FLAT	A
	0903100-33	WASHER, FLAT	B
	0903100-39	WASHER, FLAT	C
14	0911100-99	RING, RETAINING	A
	0911100-100	RING, RETAINING	B
	0911100-101	RING, RETAINING	C
15	903100-42	WASHER, FLAT	A
	AN960-716	WASHER, FLAT	B
	903100-43	WASHER, FLAT	B
	903100-45	WASHER, FLAT	C
16	1801218-03	DRUM, TORQUE	A
	1801275-03	DRUM, TORQUE	B
	1801206-01	CARRIER, TORQUE	C
17	1801538-01	RING, KEEPER	A
	1801539-01	RING, KEEPER	B
	1801540-01	RING, KEEPER	C
18	1801613-01	SPRING, CAPSTAN	A
	1801614-01	SPRING, CAPSTAN	B
	1801615-01	SPRING, CAPSTAN	C
19	1801538-01	RING, KEEPER	A
	1801539-01	RING, KEEPER	B
	1801540-01	RING, KEEPER	C
20	1801235-01	NUT, BEARING RETAINER	A
	1801262-01	NUT, BEARING RETAINER	B
	1801214-01	NUT, BEARING RETAINER	C
21	1801236-01	RACE, THRUST OUTER (FOR REPLACEMENT ORDER KIT NO. 1811041-01)	A
	1811041-01	KIT, THRUST BEARING (REPLACEMENT FOR PART NO. 1801236-01)	A
	1801442-01	RACE ASSEMBLY, OUTER (FOR REPLACEMENT ORDER KIT NO. 1811042-01	B

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3.0 PSA-1, PSA-3 AND PSA-10 CROSSSECTION, HARDWARE PARTS NUMBERS AND HARDWARE PARTS LIST (continued)

FIG & INDEX NO.	PART NO.	DESCRIPTION	USABLE ON CODE
	1811042-01	KIT, THRUST BEARING (REPLACEMENT FOR PART NO. 1801442-01)	B
	1801443-01	RACE ASSEMBLY, OUTER (FOR REPLACEMENT ORDER KIT NO. 1811043-01	C
	1811043-01	KIT, THRUST BEARING (REPLACEMENT FOR PART NO. 1801443-01)	C
22	1801493-02	BALL (0.1860 INCH/40724 MM DIAMETER) (INCLUDED IN KIT NO. 1811041-01)	A
	1801493-03	BALL (0.1865 INCH/40737 MM DIAMETER) (INCLUDED IN KIT NO. 1811041-01)	A
	1801493-02	BALL (0.1860 INCH/40724 MM DIAMETER) (INCLUDED IN KIT NO. 1811042-01)	B
	1801493-03	BALL (0.1865 INCH/40737 MM DIAMETER) (INCLUDED IN KIT NO. 1811042-01)	B
	1801493-02	BALL (0.1860 INCH/40724 MM DIAMETER) (INCLUDED IN KIT NO. 1811043-01)	C
	1801493-03	BALL (0.1865 INCH/40737 MM DIAMETER) (INCLUDED IN KIT NO. 1811043-01)	C
23	0911100-82	RING, RETAINER	A,B,C
24	AN565B8H3	SETSCREW	A
	AN565B1032H4	SETSCREW	B
	AN565B1032H3	SETSCREW	C
25	1801860-01	PLUG ASSEMBLY, END	A
	1801858-01	PLUG ASSEMBLY, END	B
	1801856-01	PLUG ASSEMBLY, END	C
26	1801227-01	CYLINDER, TELESCOPING	A
	1801270-01	CYLINDER, TELESCOPING	B
	1801211-01	CYLINDER, TELESCOPING	C
27	1801382-01	SCREW ASSEMBLY, BALL BEARING	A
	1801324-01	SCREW ASSEMBLY, BALL BEARING	B
	1801384-01	SCREW ASSEMBLY, BALL BEARING	C
28	1801287-01	KEY, MACHINE	A
	1801280-03	KEY, MACHINE	B
	1801298-01	KEY, MACHINE	C
29	1801230-01	RACE, INNER THRUST (FOR REPLACEMENT ORDER KIT NO. 1811041-01)	A

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3.0 PSA-1, PSA-3 AND PSA-10 CROSSSECTION, HARDWARE PARTS NUMBERS AND HARDWARE PARTS LIST (continued)

FIG & INDEX NO.	PART NO.	DESCRIPTION	USABLE ON CODE
	1811041-01	KIT, THRUST BEARING (REPLACEMENT FOR PART NO. 1801230-01)	A
	1801264-01	RACE, INNER THRUST (FOR REPLACEMENT ORDER KIT NO. 1811042-01)	B
	1811042-01	KIT, THRUST BEARING (REPLACEMENT FOR PART NO. 1801264-01)	B
	1801391-01	RACE, INNER THRUST (FOR REPLACEMENT ORDER KIT NO. 1811043-01)	C
	1811043-01	KIT, THRUST BEARING (REPLACEMENT FOR PART NO. 1801391-01)	C
30	MS24694-S1	SCREW, FLATHEAD	A,B
	MA24694-S92	SCREW, FLATHEAD	C
31	MS35790-9	WASHER, LOCK	A,B
	MS35790-25	WASHER, LOCK	C
32	1801234-01	KEY, ANTI-ROTATION	A
	1801265-01	KEY, ANTI-ROTATION	B
	1801212-01	KEY, ANTI-ROTATION	C
33	1801226-01	CYLINDER, SUPPORT	A
	1801277-01	CYLINDER, SUPPORT	B
	1801210-01	CYLINDER, SUPPORT	C
34	AN535-2-2	SCREW, DRIVE	A,B,C
35	1801301-01	NAMEPLATE	A,B,C

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3.1 Pacific Scientific Mechanical Snubber (PSA-35 AND PSA-100) Design and Operation

Figure 5 is a cross section that represents the PSA-35, and PSA-100 snubbers. Also, Figure 6 shows the part numbers of the snubbers.

The PSA-35 and PSA-100 snubbers are the largest capacity Pacific Scientific snubbers manufactured. Their external configuration is similar but distinctive from other PSC snubbers. In addition to being much larger, the outside diameter is essentially the same throughout its length.

The snubber consists of a support cylinder assembly, torque carrier assembly, an inertia mass assembly, an adapter nut or transition tube, an end cap assembly, and end cap nut, and a position indicator tube. A dust cover is installed in the adapter nut, or transition tube, to prevent contaminants from entering the arrestor internal mechanisms. The support cylinder assembly includes a support cylinder, a telescoping cylinder, a capstan spring, a recirculating ball assembly, ball bearings, a system of planetary gears, a ring gear and a housing.

The recirculating ball assembly is attached to and travels with the telescoping cylinder, as do the externally mounted end cap assembly, end cap nut and indicator tube. The opposite end of the recirculating ball assembly is keyed to the inner race of the thrust bearing assembly which is coupled to the planetary gear system. The outer race of the ball bearing and the ring gear are fitted into the bore of the support cylinder housing. This arrangement translates rotation of the precision ball screw into rotation of the planetary gears. The capstan and an internally mounted ball bearing are installed in the support cylinder housing at the output side of the planetary gear system. The capstan is keyed to the housing and does **NOT** rotate. Installed in the support cylinder housing, but **NOT** part of the support cylinder assembly, are a torque carrier assembly, an inertia mass assembly and a capstan spring. The pinion gear of the torque carrier assembly engages the planetary gears. The hub of the torque carrier is supported by the internal bearing of the capstan. The capstan spring is internally contained in the torque carrier shell and rotates with the torque carrier. The hub of the inertia mass assembly is supported in a needle bearing installed in the torque carrier assembly. A clutch spring is installed in the bore of the inertia mass assembly. The lips of the clutch spring are centered on the slot in the inertia mass shell. The tangs of the capstan spring are centered between the lips of the clutch spring. In this manner, the torque carrier assembly is coupled to the inertia mass assembly.

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3.1 Pacific Scientific Mechanical Snubber (PSA-35 AND PSA-100) Design and Operation (continued)

The operation of these larger size PSA's is generally the same as for the other sizes as described. The use of the planetary gear system permits the use of a reasonable size inertia mass because the gear system rotates the mass at a greater speed than the ball screw turns.

The restraining function of the PSA-35 and -100 snubbers is accomplished by translating linear motion of the telescoping cylinder, within the support cylinder assembly, into rotary motion of the output gear train, the torque carrier assembly and the inertia mass assembly. As the snubber is extended or retracted, the telescoping cylinder moves inside the support cylinder. The recirculating ball assembly is fixed to the telescoping cylinder, and the telescoping cylinder is prevented from rotating by the anti-rotation key attached to the stationary support cylinder. Therefore, as the recirculating ball assembly is moved in or out with the telescoping cylinder, the ball screw is forced to rotate, and the torque carrier spins with it. The tangs of the capstan spring drive the inertia mass, and if the speed is changed gradually, the spring does **NOT** tighten down on the end of the support cylinder. If the speed changes suddenly, either slowing down or increasing the inertia mass displaces the tangs of the capstan spring and closes the spring down on the end of the support cylinder, acting as a brake. The arresting action of the snubber is essentially the same as for all the other PSA mechanical snubbers.

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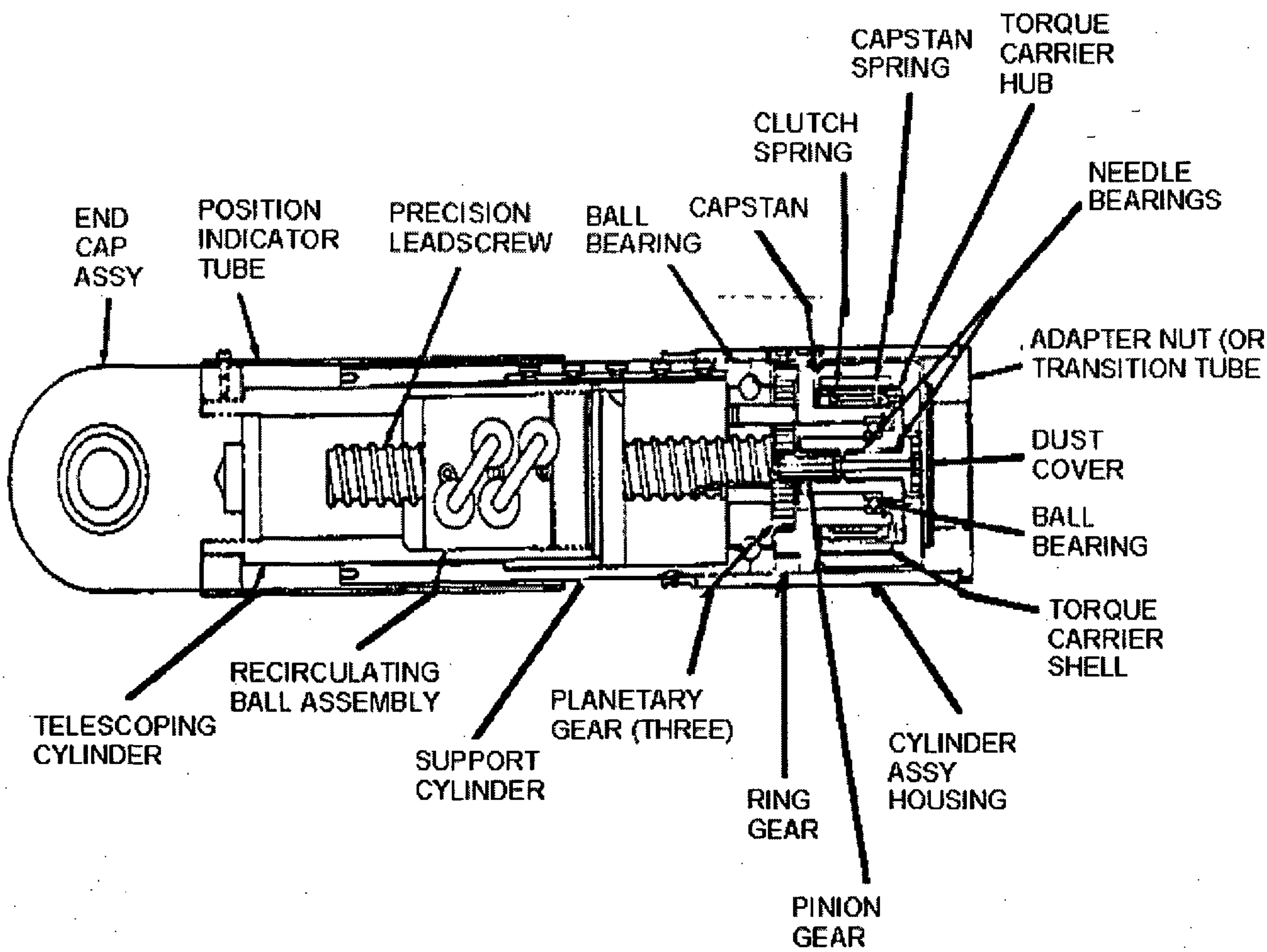
4.0 PSA-35 AND PSA-100 CROSSSECTION, HARDWARE PARTS NUMBERS AND HARDWARE PARTS LIST



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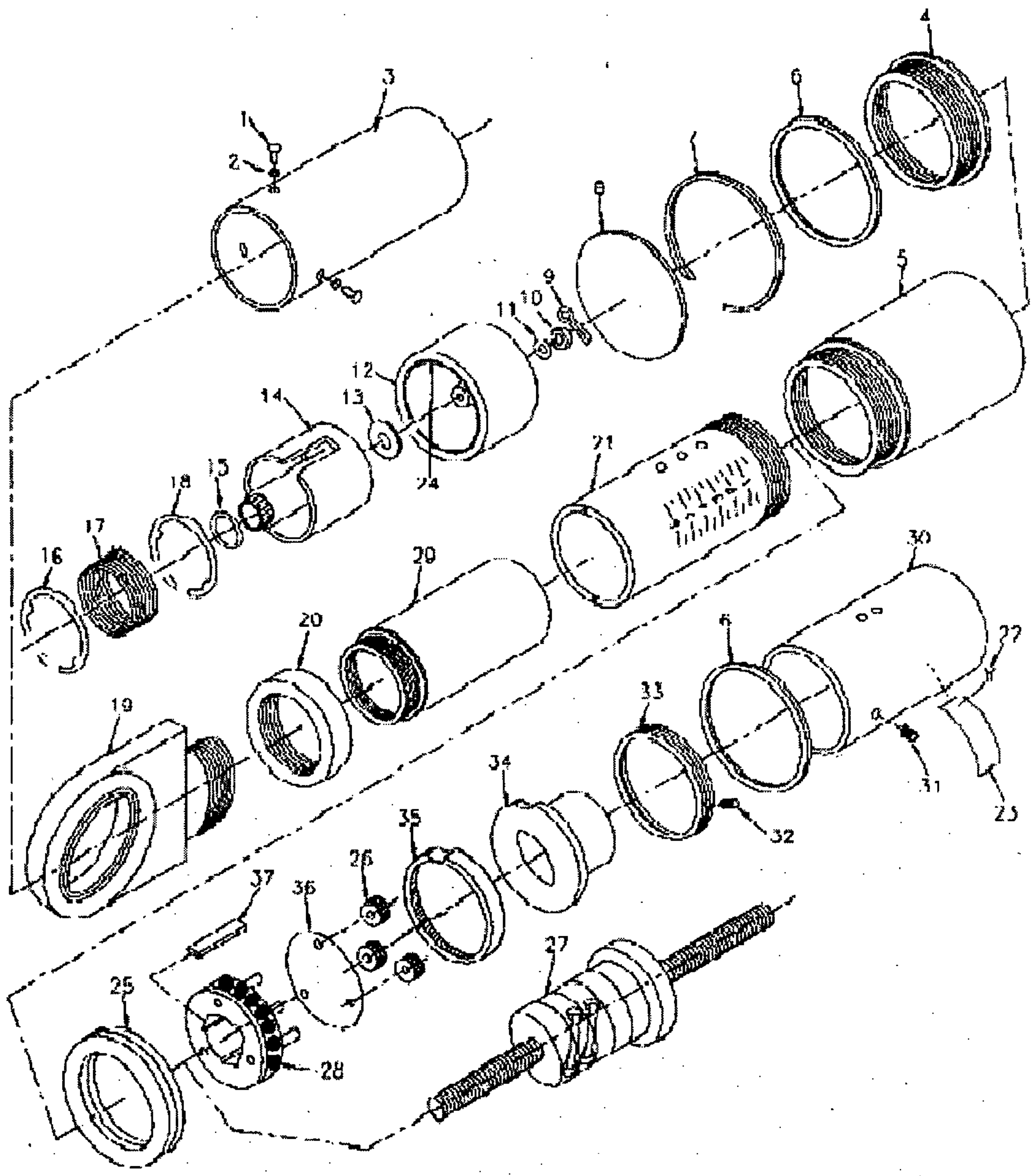
4.0 PSA-35 AND PSA-100 CROSSSECTION, HARDWARE PARTS NUMBERS AND HARDWARE PARTS LIST (continued)



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4.0 PSA-35 AND PSA-100 CROSSSECTION, HARDWARE PARTS NUMBERS AND HARDWARE PARTS LIST (continued)

FIG & INDEX NO.	PART NO.	DESCRIPTION	USABLE ON CODE
	1801112-09	ARRESTOR, MECHANICAL SHOCK, MODEL PSA-35	A
	1801112-11	ARRESTOR, MECHANICAL SHOCK, MODEL PSA-35	B
	1801112-13	ARRESTOR, MECHANICAL SHOCK, MODEL PSA-35	C
	1801119-09	ARRESTOR, MECHANICAL SHOCK, MODEL PSA-100	D
	1801119-11	ARRESTOR, MECHANICAL SHOCK, MODEL PSA-100	E
	1801119-13	ARRESTOR, MECHANICAL SHOCK, MODEL PSA-100	F
1	AN501-416-8	SCREW, FILISTER HEAD	A,B,C
	AN501-561-10	SCREW, FILISTER HEAD	D,E,F
2	AN960-416L	WASHER, FLAT	A,B,C
	AN960-516L	WASHER, FLAT	D,E,F
3	1801455-03	TUBE, INDICATOR	A,B,C
	1801438-03	TUBE, INDICATOR	D,E,F
4	1801506-05	NUT,ADAPTER	A
	1801506-07	NUT,ADAPTER	B
	1801507-05	NUT,ADAPTER	D
	1801507-07	NUT,ADAPTER	E
5	1801480-01	TUBE, TRANSITION	C
	1801478-01	TUBE, TRANSITION	F
6	1801497-01	WASHER, LOCKING	A,B,C
	1801526-01	WASHER, LOCKING	D,E,F
7	0911100-80	RING, RETAINING	A,B,C
	0911100-106	RING, RETAINING	D,E,F
8	1801260-01	COVER, DUST	A,B,C
	1801217-03	COVER, DUST	D,E,F
9	MS24665-152	PIN, COTTER	ALL
10	AN310-4	NUT, CASTELLATED	ALL
11	AN960-416	WASHER, FLAT	A,B,C
	AN960-416L	WASHER, FLAT	D,E,F
12	1801868-01	INTERIA MASS ASEMBLY	A,B,C
	1801863-01	INTERIA MASS ASEMBLY	D,E,F
13	0903100-45	WASHER	D,E,F
14	1801867-01	CARRIER ASSEMBLY, TORQUE	A,B,C
	1801865-01	CARRIER ASSEMBLY, TORQUE	D,E,F
15	0903100-48	WASHER, (PSA-35)	A,B,C
	1801524-01	RING, WEAR, (PSA-100)	D,E,F
16	1801540-01	RING, KEEPER	A,B,C
	1801611-01	RING, KEEPER	D,E,F
17	1801615-01	SPRING,CAPSTAN	A,B,C
	1801617-01	SPRING, CAPSTAN	D,E,F
18	1801540-01	RING, KEEPER	A,B,C
	1801611-01	RING, KEEPER	D,E,F
19	1801546-03	CAP ASSEMBLY, END	A,B,C
	1801545-03	CAP ASSEMBLY, END	D,E,F

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4.0 PSA-35 AND PSA-100 CROSSSECTION, HARDWARE PARTS NUMBERS AND HARDWARE PARTS LIST (continued)

FIG & INDEX NO.	PART NO.	DESCRIPTION	USABLE ON CODE
20	1801451-03	NUT, END CAP	A,B,C
	1801432-03	NUT, END CAP	D,E,F
21	1801457-77	CYLINDER ASSEMBLY, SUPPORT	A,B,C
	1801430-77	CYLINDER ASSEMBLY, SUPPORT	D,E,F
22	AN535-2-2	SCREW, DRIVE	ALL
23	1801301-01	NAMEPLATE	ALL
24	1801201-01	SPRING, CLUTCH	A,B,C
	1801409-01	SPRING, CLUTCH	D,E,F
25	1801670-01	THRUST BEARING ASSEMBLY (KIT)	A,B,C
	1801673-01	THRUST BEARING ASSEMBLY (KIT)	D,E,F
26	1801465-01	PLANETARY GEARS	A,B,C
	1801419-01	PLANETARY GEARS	D,E,F
27	1801734-01	RECIRCULATION BEARING ASSEMBLY	A,B,C
	1801671-01	RECIRCULATION BEARING ASSEMBLY	D,E,F
28	1801521	BEARING BALLS	A,B,C
	1801525	BEARING BALLS	D,E,F
29	1801456-01	TELESCOPING CYLINDER	A,B,C,
	1801434-01	TELESCOPING CYLINDER	D,E,F
30	1801453-77	HOUSING ASSEMBLY	A,B,C
	1801428-77	HOUSING ASSEMBLY	D,E,F
31	AN565DC524H5	SET SCREW	ALL
32	AN565-E428H4	SET SCREW	A,B,C
	AN565-E524H5	SET SCREW	D,E,F
33	1801477-03	LOCKING RING	A,B,C
	1801445-03	LOCKING RING	D,E,F
34	1801458-01	CAPSTAN	A,B,C
	1801421-01	CAPSTAN	D,E,F
35	1801466-01	RING GEAR	A,B,C
	1801420-01	RING GEAR	D,E,F
36	1801476-01	WASHER PLATE	A,B,C
	1801440-01	WASHER PLATE	D,E,F
37	MS20066-A-353	THRUST BEARING MACHINE KEY	A,B,C
	MS20066-A-256	THRUST BEARING MACHINE KEY	D,E,F

5.0 THE TYPES AND SIZES FOR THE MECHANICAL SNUBBERS:

- PSA-1/4, 0.35 Kips, 4 inch stroke (Bergen-Paterson part number 2540-.35 or 2410-.35).
- PSA-1/2, 0.65 Kips, 2.5 inch stroke (Bergen-Paterson part number 2540-.65 or 2410-.65).
- PSA-1, 1.5 Kips, 4 inch stroke (Bergen-Paterson part number 2540-1.5 or 2410-1.5).
- PSA-3, 6 Kips, 5 inch stroke (Bergen-Paterson part number 2540-6 or 2410-6).
- PSA-10, 15 Kips, 6 inch stroke (Bergen-Paterson part number 2540-15 or 2410-15).
- PSA-35, 50 Kips, 6 inch stroke (Bergen-Paterson part number 2540-50 or 2410-50).
- PSA-100, 120 Kips, 6 inch stroke (Bergen-Paterson part number 2540-120 or 2410-120).

6.0 TEST PARAMETERS IN THE SNUBBER TEST MACHINE PROGRAM:

The following parameters shall be verified to work on the test machine, with the associated snubbers, and the accompanying plot shall be located as close to the center of the graph as possible. If the plot does **NOT** show in the center of the graph the following parameters may be changed to center the plot and give the best looking plot available.

- Valve Open - This value is in percent of command output. If the operator wishes to start the valve sooner the percent value may be reduced, which will require the valve to open sooner causing the command ramp to "jump" up to an initial value and overcome the dead band.
- Valve End - The valve end value allows the operator to set an endpoint for the proportional valve opening at less than 100 percent full open. If the operator wishes the profile to extend or reduce this value should be increased or decreased, as necessary. This value has to be controlled enough that the snubber will activate, prior to the end of the test. This value controls the ramp profile in the activation tests.

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6.0 TEST PARAMETERS IN THE SNUBBER TEST MACHINE PROGRAM: (continued)

- Ramp Duration - This value sets the time duration of the ramp between valve start and valve end. This value may be decreased, which moves the plot to the left on the graph. In the acceleration tests this value is limited to.45 sec maximum.

- Load Duration - This is the time that the valve will remain at the valve end position, after the ramp time has elapsed. Adjusting this value "up" will assure that the complete test will show on the graph.

TPYE	PSA 1/4	PSA 1/2	PSA 1	PSA 3	PSA 10	PSA 35	PSA 100
KIP RATING	.35	.65	1.5	6	15	50	120
STROKE	2.5	2.5	4	5	6	6	6
ACTIVATION RATE	0	0	0	0	0	0	0
RELEASE RATE	0	0	0	0	0	0	0
AS LEFT/AS FOUND ACCELERATION RATE	.02/.04	.02/.04	.02/.04	.02/.04	.02/.04	.02/.04	.02/.04
DRAG FORCE LIMIT	5	5	5	5	5	5	5
TEST LOAD	60	60	50	60	60	50	50
PRESSURE BOOST	100	100	100	100	120	100	100
VALVE START	0	0	0	0	0	0	0
VALVE END	100	100	100	100	100	100	100
DRAG SPEED	2	2	2	2	2	2	2
RAMP DURATION	.35	.35	.25	.25	.24	.35	.35
LOAD DURATION	.35	.35	.25	.25	.24	.35	.35
BENCH (B)IG/(S)MALL	S	S	S	S	B	B	B

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Service Life Monitoring Recommendations

Service life monitoring enables plant personnel to gain knowledge of the plant's operating environment and the associated capabilities of snubbers. Service life monitoring also helps to identify and control problem applications and establish practical scheduled maintenance intervals based on realistic expectations of snubber aging.

Current practices call for periodic visual examinations and functional testing of both hydraulic and mechanical snubbers. Visual examination of 100% of all safety-related snubbers is performed on a standard inspection interval controlled by NRC Generic Letter 90-09. The inspection interval may be shortened or lengthened depending on the number of inoperable snubbers found. The examination plan assumes a constant frequency of occurrence of snubber failures and is intended to ensure that no more than one snubber is inoperable at a given time. A plant can either maintain a low snubber failure rate or inspect snubbers more frequently.

Current practices also call for testing of a sample batch of snubbers during each operating cycle. Testing of an additional sample for each inoperable snubber is also normal practice. In contrast to the visual examination plan, the functional test plan is **NOT** time-related. It simply ensures a given snubber operability level at the time the testing is completed.

As plant specific knowledge of snubber aging is gained through effective service life monitoring, it is anticipated that less emphasis will be placed on such statistical plans. Our Technical Requirements Manual does **NOT** require a specific service life monitoring program to be established. This is handled by our functional testing, visual examinations and other maintenance history for the snubbers. The ASME OM Code (Subsection ISTD) and NRC NUREG/CR-5870 give recommendations for establishing a service life monitoring program.

Snubbers located in isolated severe environments should be separated from the general population and managed on a case-by-case basis. It may be desirable to group the general snubber population into two or more sub-populations with separate service lives.

1.0 PURPOSE

Degradation due to service environment and maintenance errors can adversely affect snubber performance. This Appendix discusses methods and considerations that can be used to predict and reevaluate snubber service life to optimize snubber availability during plant operation. A service life monitoring program should be based on knowledge of the operating environment, snubber design limits and service records.

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2.0 PREDICTED SERVICE LIFE

Before entering a snubber into service, its service life should be conservatively predicted, based on manufacturer recommendations and design review.

Manufacturer recommendations may include seal and fluid replacement intervals for hydraulic snubbers and critical parts or snubber replacement intervals for mechanical snubbers. Such intervals may vary, depending on the application.

Snubber design review should consider materials, design features and the plant operating environment. Evaluation of the effects of the environment on critical snubber parts such as seals, hydraulic fluid, lubricants, platings, etc., should be particularly emphasized.

3.0 SERVICE LIFE REEVALUATION

Service life reevaluation should include the following considerations.

3.1 Knowledge, Determination and Documentation of the Operating Environment

Service life monitoring takes into consideration the capability of the various snubber models to endure the full range of plant environments. Actual plant operating environments can differ significantly from the original plant design specifications. Some snubbers may be subjected to localized high temperatures that are **NOT** representative of the general snubber population. Such applications may require augmented inspections or more frequent snubber overhaul or replacement than originally predicted. Indicators of severe operating conditions can often be identified during snubber overhauls and other maintenance related activities.

The operating environment for the majority of snubbers may be significantly less severe than described in the plant design specifications. Therefore, unnecessary overhauls or replacements may increase the number of failed or degraded snubbers due to handling or maintenance errors.

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3.1 Knowledge, Determination and Documentation of the Operating Environment (continued)

It is important that the operating environment be identified and appropriate maintenance intervals established for the various snubber applications in the plant and appropriate applicable service life established. Environmental parameters may include the following:

- temperature
- vibration
- transient loading
- radiation
- humidity
- airborne contaminants (e.g., sand and dusts)
- leakage of adjacent pipes or equipment

Severe environments may be identified by plant operating data, direct measurement of environmental parameters, evaluation of installed location (e.g., proximity to high temperature components) or by examination of snubbers (or snubber parts).

Determining specific environmental information often involves specialized instrumentation and equipment that would be impractical for use at every snubber location. Such equipment should be used in applications where moderate to severe environments are anticipated or as a diagnostic aid in determining the cause of snubber degradation or failure.

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3.1.1 Direct Measurement of Environmental Parameters

Various types of instrumentation and equipment are available for direct measurement of environmental parameters such as temperature, vibration, radiation and humidity. Such equipment may be used for specific snubber locations where severe environments are expected or as an aid in determining the cause of snubber degradation.

A. Temperature

Continuous temperature recording devices are available to indicate the general area temperatures within the plant (which often vary by elevation) or to measure local snubber or component temperatures. Temperature sensitive tape may be placed directly on the snubber to determine the maximum temperature. One shortcoming of this approach is that a time/temperature profile is **NOT** provided. Contact and non contact temperature devices (e.g., infrared type) are also available.

B. Radiation

Normal radiation levels of an operating plant do **NOT** usually contribute significantly to snubber degradation. This is probably due to the following considerations:

1. actual in-plant radiation levels are, in most cases, less than was originally anticipated
2. the snubber body provides a significant amount of shielding
3. originally anticipated radiation effects were based upon 40-year dose; in actuality, snubber parts that are sensitive to radiation degradation are replaced at intervals that are significantly less than 40 years.

Data pertaining to plant radiation levels can generally be obtained from Radiological Control area surveys. Measurements of radiation levels specifically for service life monitoring is **NOT** recommended except in evaluating the cause of snubber degradation in cases where other causes have been ruled out.

3.1.1 Direct Measurement of Environmental Parameters (continued)

C. Vibration

Vibration may be continuous, in which case snubbers may degrade in as little time as one operating cycle. Vibration may also be intermittent (e.g., during pump startup), in which case it may be undetected for long periods and result in long-term degradation of the snubber. The available methods for detecting and measuring vibration vary from simple visual observation, detection by feel, portable vibration measuring instrumentation and remote vibration measuring equipment.

Snubbers subject to vibration can often be detected by visual examination. Metal filings, darkened hydraulic fluid, deformed connecting pins, elongated attachment holes and fretting of mating parts are all signs of vibration effects.

D. Transients

As with vibration, the existence of dynamic load transients may be identified during routine snubber inspections, augmented inspections and failure evaluation. Deformed structural members, jammed snubbers and deformed internal parts are all potential indicators of dynamic overloading. Inplace devices such as load measuring clevis pins are available for monitoring snubber loads where such transients are suspected.

3.2 Knowledge of Operating Environment Effects

Reevaluation of a snubber service life should include a thorough knowledge of the effects of various operating environments on snubber performance.
Such knowledge may **NOT** be readily available from the manufacturer and may require engineering evaluation, including monitoring of trendable degradation parameters for snubbers removed from service. This might include periodic measurement of potentially trendable test parameters (e.g., drag force) for selected snubbers. Periodic disassembly and evaluation of snubber internal parts (e.g., seals, springs, fluid, etc.) may also be required.

Degraded snubbers may be identified by visual examination of snubbers or their parts, by sampling of hydraulic fluid or evaluation of characteristics including time traces (e.g., load and velocity), obtained during testing.

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3.2.1 Managing Snubbers in Severe Operating Environments

Significant environmental stressors that can effect snubber performance include overloading, vibration, elevated temperature, moisture, chemicals and radiation. Snubbers operating in severe environments can be identified as plant operation continues. Such applications are often **NOT** identified until the snubbers are functionally tested. This supports the need for some random functional testing, but the extent of functional testing required by the Technical Requirements Manual may **NOT** be necessary as plants gain empirical knowledge pertaining to the plant operating environments and the associated snubber capabilities.

Snubber failures involving severe operating environments may be mitigated by conducting augmented inspections, periodic maintenance, periodic replacement with like kind, retrofitting with snubbers more suitable for the environment or eliminating the snubber by approved engineering analysis methods.

3.2.2 Augmented Surveillance Practices

A number of practices may be used for evaluating snubbers for degradation and identifying operating environments. Since evaluation methods often do **NOT** employ quantifiable parameters, judgment is required on the part of the evaluating person. Experience of the evaluating person is therefore important.

A. Hand Stroking

Probably the most common "hands-on" evaluation method is hand stroking of mechanical snubbers. This method is often used to identify snubbers that are damaged or jammed due to transients. In using this method, the evaluating person removes the connecting pin at one end of the snubber and slowly strokes the snubber while feeling and listening for abnormalities such as intermittent or continuous excess noise or resistance.

Using this method, an experienced person can often identify impending failure. An example, during hand stroking of a mechanical snubber, is periodic resistance accompanied by a chaffing sound for each revolution of the inertia mass. This indicates binding caused by lack of concentricity of the rotating parts. Irregular, intermittent noise and resistance indicates surface discontinuities on the lead screw.

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3.2.2 Augmented Surveillance Practices (continued)

B. Rotation of Snubbers in Place

Jammed snubbers (i.e., snubbers unable to allow free thermal motion) may often be identified by attempting to rotate the snubber about its spherical end attachment bearings. If the snubber is **NOT** free to rotate, it is possible that axial loading exists, resulting in jamming or premature lockup. It should be noted that this method is most effective for snubbers with a load capacity of 3,000 lbs. or less. Normal friction in the bearings often prevents rotation of larger sizes.

C. Hand Detection of Vibration

Hand detection of vibration, by placing a hand on the snubber during operation, is a useful technique for evaluating accessible snubbers.

D. End of Outage Examination

Just prior to startup, reinspection of snubbers that are susceptible to damage due to outage-related activities will reduce the probability of plant operation with inoperable snubbers. Future verification that consequent failures were **NOT** the result of service-related influences would be more difficult.

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3.2.3 Trending

Progressive degradation, in the general snubber population (i.e., those snubbers **NOT** subject to rapid degradation), should be monitored by trending applicable degradation parameters for a selected number of snubbers that are representative of the plant operating environment. Some important considerations in this regard are listed below:

- The establishment of baseline data is essential for identifying trends. Data to be used for identifying trends should be sufficiently accurate to demonstrate trends.

- Trending parameters that relate directly to the anticipated aging failure mode should be used. Such degradation parameters might include compression set for elastomeric seals for hydraulic snubbers or average drag force for mechanical snubbers.

  An inappropriate monitoring parameter is the use of functional test data,(i.e., locking velocity and release rate) for monitoring or trending of seal degradation. Although functional test results can be affected to some extent by seal degradation, the primary aging failure mode for snubber seals (i.e., loss of low pressure seal integrity) would **NOT** be reflected in the functional test data.

- Acceleration threshold (activation velocity) in acceleration-limiting mechanical snubbers is a potentially trendable parameter that may indicate internal snubber degradation. A decreasing acceleration threshold may indicate internal corrosion or internal friction between the inertia mass and its spindle.
  An increasing acceleration threshold may indicate weakening of the capstan spring tangs as a result of wear or a decrease in friction between the capstan spring and its braking surface.

- Although changes in active hydraulic snubber parameters [i.e., locking velocity and bleed(release) rate] can indicate snubber degradation, these parameters are **NOT** considered practical trending parameters for monitoring progressive degradation.

- Reservoir fluid level is the most appropriate parameter for monitoring snubber fluid leakage.

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3.2.4 Testing

The following functional test parameters are normally measured during inservice testing:

- Activation Velocity: Locking velocity for poppet-valve hydraulic snubbers. Acceleration threshold for acceleration-limiting mechanical snubbers.
- Release Rate: Snubber velocity at a given load, after snubber activation.
- Drag Force: Snubber resistance load at a given stroke velocity.
- Breakaway Force: Force required to initiate snubber motion.

These parameters are also useful in identifying potential degradation or determining the cause of snubber failure.

A. Evaluation of Test Results

Since existing test plans are statistically based on the number of failures, test results are often evaluated on only a pass/fail basis. Most test machines provide a continuous trace of load and velocity for both activation and drag force tests. Such traces often contain information useful in identifying snubber degradation. During mechanical snubber drag force (i.e., the number of load spikes, consistency of the load spikes, duration of load spikes, noise, variations in drag force with stroke position and directional sensitivity) are all useful in identifying potential snubber degradation or impending snubber failure. For hydraulic snubbers, traces can be used to identify air in the snubber or a clogged bleed orifice.

B. As-Found Testing

As-Found testing of snubbers removed from service can identify degradation due to severe operating environments. A considerable amount of information can be obtained by conducting post-service functional tests on snubbers removed from service. Such tests are recommended any time a snubber is removed from service, regardless of whether or **NOT** the snubber is to be reinstalled. This is a requirement of the Technical Requirements Manual at BFN.

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3.2.4 Testing (continued)

C. Diagnostic Testing

Diagnostic tests are specifically designed to obtain useful information about the condition of a particular snubber, beyond what may be available from routine testing. Diagnostic testing may often be helpful in identifying a failure or degradation mechanism before the snubber is disassembled. Repeat tests are helpful in determining the repeatability of a given anomaly. It may sometimes be desirable to vary test parameters (i.e., applied load, drag force velocity or test time duration) in order to observe the effect on snubber performance.

D. Trending Test Results

Trending is a useful tool for monitoring progressive snubber degradation. If test data are to be used for trending, the following should be considered:

1. Because the prevalent failure mode is failure to allow free thermal motion, a potential trending parameter for mechanical snubbers is drag force. This is supported by test data obtained that suggest an increase in drag force with service time for mechanical snubbers.

It is important that test data to be used for trending are consistently obtained using the same type of test machine, under the same conditions. The data from the same snubber should be used for comparison purposes.

Administrative limits for functional test results are intended to ensure replacement or repair of a given snubber before failure. It is important to have a reasonable indication that the selected test parameter is progressing toward the failure limit. Overly restrictive administrative limits can have the negative effect of limiting the amount of data available for trending. They can also encourage replacement of reliable snubbers. If test data are obtained for a different set of snubbers at each refueling outage, then the test results are **NOT** appropriate for trending. If snubbers are tested on different types of test machines, the test data are generally **NOT** adequate for identifying trends.

Another important consideration involves defining the test parameter. A test parameter may be defined in different ways for the same parameter. A test parameter must be defined both from the standpoint of snubber operability (i.e., for testing) and for service-life monitoring (i.e., for trending).

3.2.4 Testing (continued)

E. Test Equipment

The types of snubber test equipment used in the industry varies considerably. Some provide only a single value for a given test parameter (i.e., load or velocity) while others provide a continuous trace of the parameter versus time. The operation of some test equipment is totally manual, while others are fully automated. It is recommended that functional test equipment be provided with a data acquisition system (i.e., analog or digital) that is capable of providing a continuous trace of load and velocity versus time for the duration of the test. Information from such traces is useful in detecting degradation and identifying failure mechanisms.

Many test machines are totally automatic. Automatic test machines may be advantageous for required testing because operator bias is minimized. Data from automatic testers are generally acceptable for trending purposes. For diagnostic testing the test operator should be able to vary the level of various test parameters for exploratory purposes.

It should be noted that when a snubber is tested in a different type of test machine than the one previously used, a number of new variables (i.e., test control methods and parameters, data acquisition systems, etc.) are introduced that may complicate the identification of trends. For this reason, trending tests are most effectively conducted using the same test machine as well as the same test methods.

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3.2.5 External Seal Leakage Detection and Leakage Rate Determination

Minor seal leakage is common for many snubber types and applications. A number of influences can cause seal leakage. A leaking snubber does **NOT** necessarily imply inoperability nor does it necessarily require immediate snubber overhaul.

Measurement and trending of reservoir fluid level is probably the most practical approach to monitoring for external seal leakage. For this reason, reservoir fluid level should be recorded whenever fluid is added.

The location of seal leakage in many cases may be obvious by visual observation. In some cases the precise location of the seal leakage may require a time consuming follow-up evaluation.

It should be noted that in many cases, seal leakage can be the result of improper snubber assembly, defective parts, etc. A practical method for checking for seal leakage following snubber overhaul is to place the snubber on an absorbent (paper) pad, where it can be observed for a period of time, approximately 1 hour, prior to installation.

3.2.6 Visual Examination

Snubbers, at BFN, are visually examined in accordance with the Technical Requirements Manual. The intent of the examinations are to identify characteristics that might indicate snubber inoperability. Service-life monitoring examinations may be conducted at the same time as those required by the Technical Requirements Manual or separately. The qualification of personnel for such examinations is critical.

Visual characteristics, that would provide information in regard to service degradation, are listed below. These snubber attributes may be used to define a visual examination checklist for service-life monitoring.

1. Deformed structural member or piston rod
2. Loose or missing threaded fasteners
3. Cold or hot position varies from specified value
4. Evidence of corrosion
5. Evidence of solid deposits (e.g., boric acid) from leaking components
6. Loss of hydraulic fluid since previous visual examination

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3.2.6 Visual Examination (continued)

7. Metal filings on or in the vicinity of the snubber
8. Observed fluid leakage
9. Evidence of significant dark (i.e., black or dark brown) material deposit on piston rod
10. Rod wiper adhered to piston rod
11. Abnormal color of hydraulic fluid
12. Wear or deformation of clevis pins
13. Elongation of attachment holes
14. Evidence of wear on support cylinder
15. Cracked or deformed fluid reservoir
16. Evidence of foreign material (e.g., water, solid particles, etc.) in hydraulic fluid
17. Discoloration of metallic parts due to elevated temperature

3.2.7 Root-Cause Evaluation of Degraded or Failed Snubbers

Failures often result from influences (i.e., maintenance activities, construction activities and manufacturing defects) **NOT** related to service time or environment. It is important to ensure that service life, when based upon service history, is **NOT** unjustifiably influenced by such failures or degradation. Snubbers that failed inservice examinations or tests, or snubbers removed from service due to excessive degradation, should be evaluated to determine the root cause of the degradation or failure.

Failure evaluation data sheets should include information pertaining to failure mode, failure mechanism, environment, service time, abnormal conditions, visual observations, test results and test observations. Data sheets should **NOT** utilize a format that might lead the examiner to a potentially incorrect failure cause (e.g., a checklist of failure causes).

Diagnostic testing may be useful to identify the failure or degradation mechanism.

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3.2.8 Shortening or Extending Service Life

It may be necessary to shorten the service life of snubbers subjected to severe environments, such as excessively high temperatures and vibration. Snubbers in severe environments may require augmented surveillance, including "hands-on" evaluations (e.g., hand stroking) or inplace monitoring.

Where there has been minimal degradation due to the service environment, it may be appropriate to extend the previously established service life. Service life extension should be based on a technical evaluation of the snubber performance that includes knowledge pertaining to the current level of service-related degradation as well as to the degradation rate. Service life extension evaluations might include monitoring degradation parameters (i.e., seal compression set in hydraulic snubbers, *drag force in mechanical snubbers or operating experience in a similar* environment).

4.0 IMPLEMENTATION

BFN is establishing and developing service life monitoring of hydraulic and mechanical snubbers using the guidelines discussed in this Appendix. It is recognized that the gathering of data and the development of an effective database to trend snubber attributes evolves over time. Hydraulic snubber seal life is currently monitored to ensure service life is not exceeded between refueling outages when the snubbers are required to be operable. Mechanical snubber service life is being developed such that the replacement or refurbishment intervals are systematically defined. The "drop and swap" technique is used throughout the industry in which a mechanical snubber that is selected for functional testing is replaced with a refurbished (re-greased) or new snubber while the as-found snubber is tested and refurbished only to be used elsewhere as a replacement. This technique incorporates refurbished snubbers into the system to provide added service life for the snubber location. With the surplus of spare snubbers available at BFN, this technique has many positive advantages including increased personnel dose savings. During the initial implementation phase of the "drop and swap" technique for mechanical snubbers at BFN, priority will be placed for mechanical snubbers installed in severe service locations such as the Drywell.

Recommended Service Life

The service life recommendations for mechanical snubbers are a guide to facilitate the implementation of the BFN Snubber Program. Deviations from the service life recommendations are acceptable based on the review of the BFN Snubber Program Engineer or designee.

4.0 **IMPLEMENTATION (continued)**

PSA-1/4 and PSA-1/2: Snubbers installed inside primary containment are hand stroked during each refuel outage. This preventive maintenance activity along with functional testing constitutes service life monitoring for these model snubbers.

PSA-1: (High temperature service applications, drywell, RB steam tunnel, and adjacent to steam lines outside of primary containment).

These snubbers inside the primary containment installed on high temperature small bore lines and three or four inches diameter lines have not experienced functional test failures. This is attributed to the smaller amount of heat radiating from the piping systems with smaller diameter piping than the amount of heat radiating from a larger diameter pipe containing a similar process. These applications include PSA-1 snubbers installed on the Reactor Vessel Level Instrument System (RVLIS); main steam system drain lines; and HPCI and RCIC system drain lines. Additionally these applications also seem to be in general areas of the drywell where ventilation is ongoing and not adjacent to a heat sink, such as the sacrificial shield wall or a bulkhead. A recommended service life is 15 years for this application.

PSA-3: (High temperature service applications, drywell, RB steam tunnel, and adjacent to steam lines outside of primary containment)

Based on the results of the failure analyses of these PSA-3 Snubbers contained in PER 142721 (BFN-3-SNUB-001-5051), PER 136938 (BFN-3-SNUB-001-5052), and PER 169047 (BFN-2-SNUB-073-5001) and the fact that each of the snubbers had an approximate service life of 13 years, 13 years, and 15 years respectively; therefore the recommended service life for PSA-3 snubbers installed on lines greater than 4 inches in a high temperature area of the plant: inside primary containment; inside the Reactor Building Steam Tunnel; or adjacent to large steam lines outside of primary containment, is 13 years.

The PSA-3 snubbers inside the primary containment installed on high temperature lines 4 inches in diameter and less (typically small bore lines) have not experienced functional test failures. This is attributed to the smaller amount of heat generating from the piping system. The recommended service life is 15 years for this application.

PSA-10 (High temperature service applications, drywell, RB steam tunnel, and adjacent to steam lines outside of primary containment).

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4.0 IMPLEMENTATION (continued)

Based on the results of the failure analyses contained in PER 220811 (BFN-3-SNUB-001-5041), PER 220943 (BFN-3-SNUB-001-5033), and PER 221949 (BFN-3-SNUB-001-5017) and the fact that each of the snubbers had an approximate service life of at least 15 years, the recommended service life for PSA-10 snubbers installed in a high temperature area of the plant: inside primary containment; inside the Reactor Building Steam Tunnel; or adjacent to large steam lines outside of primary containment, is 13 years.

PSA-35 (High temperature service applications, drywell, RB steam tunnel, and adjacent to steam lines outside of primary containment)

Current empirical data, from the U3R14 outage, shows that PSA-35 mechanical snubbers, in these service applications, with approximately 15 years of service had very favorable functional test results. The recommended service life is 15 years. Some PSA-35 may exceed the recommended 15 year service life until the periodicity for exchange has been completed.

PSA Snubbers Empirical Observation

The following is a summary of observations based on the empirical data reviewed that can be applied to PSA mechanical model snubbers of all sizes.

PSA snubbers installed on high temperature system either directly over a large bore line or in a an area adjacent to a heat sink that will limit normal ventilation air flow or serve as a radiant heat source or insulator have a higher propensity to fail due to drying out of the lubricant on the snubber internals. These snubbers are typically installed in a lateral configuration with the main body of the snubber directly over a main steam line or steam supply line to the HPIC or RCIC system. Another example would be a snubber installed above a main steam line and adjacent to the sacrificial wall or an overhead bulkhead, structural steel support, or some other plant feature which limits local ventilation air flow.

PSA-3, -10, -35 model snubbers installed on main steam system or the steam supply to HPCI and RCIC show a higher degree of wear during disassembly than snubber with similar service lives and installed on other high temperature systems inside the drywell such as the RHR system, the RWCU system, the Reactor Feedwater system, and the Reactor Recirculation system. It is postulated that the fluid in the later systems would tend to provide a dampening effect to normal operational vibration, where those piping systems associated with steam supply experience higher vibrations due to the lack of a dampening medium inside the pipe.

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4.0 IMPLEMENTATION (continued)

PSA model snubbers manufactured or refurbished to current Basic PSA standards: lubricated with a minimum of grease; and lubricated with NRRG-2 are expected to have a longer service life. At BFN this is primarily the population of PSA model snubbers intalled on Unit 1; newly manufactured PSA model snubbers; of newly re-greased PSA model snubbers.

BP, A/DE, Fronek Hydraulic Snubbers: (High temperature service applications, drywell, RB steam tunnel, and adjacent to steam lines outside of primary containment)

Current empirical data from U2R15 and U3R14 show that the functional tests of ADH-3, ADH-10, AHD-20 and ADH-30 hydraulic model snubbers installed on the following systems main steam, RHR, Core Spray, Reactor Feedwater, and Reactor Recirculation with 10 - 11 years of service all functionally tested well. Often the "as-found" functional test result of the removed snubber was similar to the rebuilt or new "as-left" functional test of the replacement snubber. The recommended service life, for BP-A/DE and Fronek hydraulic snubbers, is the 17 year seal life.

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Hydraulic Snubber Failure Analysis Approach, Failure Modes, Indications and Failure Cause

1.0 GENERAL

In performing any snubber analysis a full investigation should be performed prior to making any determination of the failure cause. This should be done since there may be very subtle causes, which can be masked by **NOT** performing a slow and methodical investigation. All parts should be Match Marked prior to disassembly, since the disassembly of the snubber may destroy evidence of the true apparent cause of the snubber failure. In this approach a failure denotes a snubber **NOT** meeting its functional test acceptance criteria. The test data may show that the snubber is degraded or that it is a functional failure.

If solvents are required during the performance of the investigation, only approved solvents should be used to clean the parts.

2.0 SNUBBER LOCATION HISTORY DATA

[1] **GIVE** a general history of the snubber location using the following as a guideline:

- Any previous functional test or visual examinations
- Snubber location in the plant
- Snubber installed orientation
- Does the snubber have a transition tube kit or a forward bracket installed? If a transition kit is installed what is the pin-to-pin dimension?
- Which end of the snubber (transition tube/forward bracket or the snubber body) is attached to the pipe?

[2] **REVIEW** any and all previously performed snubber visual examination and functional test data.

[3] **PERFORM** a field walk down of the snubber location to determine any adverse environmental conditions, such as:

- Is the snubber in a location where it could be hit, kicked or stepped upon during maintenance activities?
- Are there any signs of pipe leakage (water, steam, etc.) in the area?

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2.0 SNUBBER LOCATION HISTORY DATA (continued)

[4] **REVIEW** the piping system records to determine if any transient events have occurred in this section of piping.

[5] **REVIEW** the piping stress analysis to determine the design loading conditions of this location, the pipe support orientations, locations and the relative stiffness of the piping system. Some examples are:

- Is this location designed to take water hammer loads or other transient loads and did one occur?
- Is this location subject to pipe vibration?
- Is this location required for seismic or is it only required for operational transient loads?

[6] **REVIEW** the piping stress analyses to determine if there are other snubbers subject to the same failure mode. An example is, if a snubber failure occurred on the "A" loop is there a similar location on the "B" loop?

[7] **CHECK** the environmental data for the snubber location:

- Harsh or mild environment
- Temperature range
- Radiation dose
- Humidity

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3.0 EXTERNAL SNUBBER EVALUATION FOR ALL SIZE HYDRAULIC SNUBBERS

In almost every case, the evaluation performed on the exterior of the snubber can give clues to the nature of the failure. Following are some things which should be looked at and evaluated during the snubber evaluation.

[1] **RECORD** the following data:

- Snubber size
- Snubber serial number
- Year of manufacture
- Manufacturer's part number
- Evaluation date

[2] **CHECK** the condition of the spherical bearing on both ends of the snubber:

NOTE
A bound or "frozen" spherical bearing can put unanalyzed forces into the snubber during thermal movements, causing internal stress or damage.

- Can they be moved by hand?
- Do they "squeak" when they are moved?
- Is there foreign material on the bearings?
- Are they rusty?
- Are the spherical bearings staked in place?
- Any signs of deformation?

[3] Is there any physical damage to the snubbers' externals:

- Ding marks on exterior surfaces
- Welding arc marks on exterior surfaces

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3.0 EXTERNAL SNUBBER EVALUATION FOR ALL SIZE HYDRAULIC SNUBBERS (continued)

[4] Are there any foreign materials on the exterior of the snubber? If so, would they interfere with the operation of the snubber?

- Duct tape
- Insulation materials
- Corrosion products
- Dirt or debris
- Paint or other coatings

[5] **CHECK** the external surfaces of the snubber for any signs of discoloration due to excessive temperatures.

[6] **FULLY EXTEND** *the snubber, if possible, and* **DENOTE** *any wear or other* types of marks found. The location and measurement (length, width and direction) of these marks and the actual snubber orientation during operation can be a vital clue as to what was happening to the snubber during operation.

One important aspect is to determine exactly what the snubber settings were prior to the failure and what the snubber settings were at the time of the failure. Some utilities perform snubber measurements from a fixed point on the snubber. These measurements are recorded during the visual examinations, as well as, being documented in the Work Orders (WO) that remove the snubber from the piping system. These measurements are usually documented to the nearest 1/32nd of an inch. The importance of these measurements is that the evaluator can measure any wear marks found on the snubber and correlate the location and lengths of these wear marks to the actual snubber settings. This information can aid the evaluator in determining if these wear marks are due to the normal snubber movements (cold or hot setting) or due to vibration in either the hot or cold position.

[7] **CHECK** the retainer ring at the housing to ensure that it was installed correctly (flat side down).

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3.0 EXTERNAL SNUBBER EVALUATION FOR ALL SIZE HYDRAULIC SNUBBERS (continued)

[8] **CHECK** the connection of the transition tube kit or the forward bracket to the snubber.

- Is the tie wire intact?
- Has the transition tube loosened from the backing plate?

[9] **SLOWLY STROKE** the snubber by hand, if possible.

- **ORIENT** the snubber, as best as possible, to the orientation that the snubber was in the field prior to stroking.
- **RECORD** any rough spots and the location (stroke location).
- **RECORD** any noises heard.
- Did the snubber stroke under its own weight or was force needed to be applied to stroke the snubber? Was the applied force excessive?
- Did the snubber “stick” at any point in the stroke?
- Did any rough spots in the stroke correspond to any mark locations?

[10] **MATCH MARK** the transition tube kit or forward bracket to the snubber body and **REMOVE** the transition tube kit or forward bracket.

Throughout the disassembly process, all parts should be checked for any signs of contamination, damage or wear.

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4.0 INTERNAL SNUBBER EVALUATION FOR ALL SIZE HYDRAULIC SNUBBERS

The evaluation guidelines that follow will highlight the prime areas of concern for the snubber components. The following instruments may be used for the evaluation and in particular when any doubt persists as to the cause of the failure.

- Flat machinist's Surface Plate
- Surface Comparitor/Surface Profilometer
- Dial bore gauges
- Plug gauges

4.1 Evaluation of the Snubber Reservoir:

[1] Using the appropriate plant procedures, **REMOVE** the reservoir hold down screws and **LIFT** the reservoir from the control valve assembly and snubber body. After removal **PERFORM** the following inspections and evaluations:

- **INSPECT** the "O" Ring seal between the reservoir and the control valve assembly for deterioration, cuts or other damage.
- **INSPECT** the matting surfaces between the reservoir, the control valve assembly and the snubber front head for rust, pits, scratches and straightness.

[2] **MATCH MARK** each piece and **DISASSEMBLE** the reservoir in the following order and **PERFORM** the inspections and evaluations as follows:

- **REMOVE** the tie rods from the reservoir and **INSPECT** the threads of the rods and nuts.
- **REMOVE** the rear cap and **INSPECT** the tube ends, the "O" Ring and the "O" Ring contact surfaces.

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4.1 Evaluation of the Snubber Reservoir: (continued)

[3] **RELEASE** the pressure from the reservoir piston spring and **REMOVE** the piston and spring. **INSPECT** the reservoir parts as follows:

- **REMOVE** and **INSPECT** the reservoir piston packing for any imperfections, degradation or nicks.
- **INSPECT** the reservoir piston sealing areas for rough surfaces or nicks.
- **INSPECT** the piston and reservoir tube contact areas for surface imperfections, nicks or rough spots. If nicks or rough spots persist on the largest diameter, **DISCARD** the part.
- **INSPECT** the spring for mechanical damage, breakage or corrosion. If any are evident **DISCARD** and **REPLACE** the part.
- **REMOVE** and **INSPECT** the reservoir bleeder screw threads.
- **INSPECT** the “O” Ring and sealing surface under the screw head.

4.2 Evaluation of the Snubber Control Valve Assembly:

[1] Using the appropriate plant procedures, **REMOVE** the control valve assembly hold down screws and **LIFT** the control valve assembly from the snubber body. After removal **PERFORM** the following inspections and evaluations:

- **INSPECT** the “O” Ring seal between the control valve assembly and the snubber body for deterioration, cuts or other damage.
- **INSPECT** the mating surfaces between the control valve assembly and the snubber rear cap for rust, pits and scratches.

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4.2 Evaluation of the Snubber Control Valve Assembly: (continued)

[2] **MATCH MARK** each piece, **DISASSEMBLE** the control valve assembly and **PERFORM** the inspections and evaluations as follows:

- **REMOVE** and **INSPECT** the threads, "O" Rings and sealing surfaces of the 3 SAE port plugs for deterioration, degradation, rust, nicks or pits.
- **REMOVE** the compression poppet stop and plug, the extension connector tube and **INSPECT** the threads, "O" Rings and sealing surfaces for deterioration, degradation, rust, nicks or pits.
- **REMOVE** and **INSPECT** the compression and extension poppets for degradation, rust, nicks or pits on the head and the conical bleed groove area.
- **INSPECT** the compression and extension poppet seat areas for degradation, rust, nicks or pits.
- **INSPECT** the poppet springs for mechanical damage, weakness, breakage or corrosion. If any are evident **DISCARD** and **REPLACE** the part.
- **REMOVE** the relief valve plug, ball and spring and **PERFORM** the same inspections as listed above.

4.3 Evaluation of the Snubber Main Body:

[1] Using the appropriate plant procedures, **DISASSEMBLE** the main snubber body. After removal **MATCH MARK** each piece and **PERFORM** the inspections and evaluations as follows:

- **REMOVE** the tie rods from the main snubber body and **INSPECT** the threads of the rods and nuts.
- **REMOVE** the rear cap and **INSPECT** the tube ends, the "O" Ring and the "O" Ring contact surfaces.
- **REMOVE** and **INSPECT** the main piston rings for any imperfections, degradation or nicks.
- **INSPECT** the main piston sealing areas for rough surfaces or nicks.

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4.3 Evaluation of the Snubber Main Body: (continued)

- **INSPECT** the piston and main cylinder tube contact areas for surface imperfections, nicks or rough spots. If nicks or rough spots persist on the largest diameter, **DISCARD** the part.

- **REMOVE** the front head and **INSPECT** the tube ends, the "O" Ring and the "O" Ring contact surfaces.

- **INSPECT** the rod bearing gland contact areas for surface imperfections, nicks or rough spots. If nicks or rough spots persist on the largest diameter, **DISCARD** the part.

- **REMOVE** and **INSPECT** the rod bearing gland rod packing contact areas for surface imperfections, nicks or rough spots.

- **REMOVE** and **INSPECT** the piston rod wiper and contact surface for imperfections, nicks or rough spots.

- **REMOVE** and **INSPECT** the threads, "O" Rings and sealing surface of the front head port plug for deterioration, degradation, rust, nicks or pits.

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5.0 HYDRAULIC SNUBBER FAILURE MODES, INDICATIONS AND FAILURE CAUSE

FAILURE MODE	INDICATIONS	FAILURE CAUSE
LOW FLUID LEVEL	LEAKAGE	OVER LOAD OR TRANSIENT
	IMPROPER FILLING AND PURGING	MAINTENANCE OR MANUFACTURE
LOW LOCKING VELOCITY	FIELD TAMPERING	MAINTENANCE
	IMPROPER INITIAL SETTING	MAINTENANCE
	LOW TEST TEMPERATURE	TESTING
	IMPROPER TEST	TESTING
	FLUID VISCOSITY CHANGE	ENVIRONMENT
	INCORRECT FLUID	MAINTENANCE
	INADEQUATE PURGE	MAINTENANCE
	INCORRECT VALVE PARTS	MAINTENANCE OR MANUFACTURE
LOW BLEED FATE	CLOGGED BLEED ORIFICE	ENVIRONMENT OR MAINTENANCE
	FIELD TAMPERING	MAINTENANCE
	IMPROPER INITIAL SETTING	MAINTENANCE
	LOW TEST TEMPERATURE	TESTING
	IMPROPER TEST	TESTING
	FLUID VISCOSITY CHANGE	ENVIRONMENT
	INCORRECT FLUID	MAINTENANCE OR MANUFACTURE
	INADEQUATE PURGE	MAINTENANCE
HIGH LOCKING VELOCITY	AIR IN FLUID	MAINTENANCE
	INTERNAL SEAL BY-PASS	MAINTENANCE
	FIELD TAMPERING	MAINTENANCE
	IMPROPER INITIAL SETTING	MAINTENANCE, MANUFACTURE, UNKNOWN OR TESTING
	HIGH TEST TEMPERATURE	MAINTENANCE

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5.0 HYDRAULIC SNUBBER FAILURE MODES, INDICATIONS AND FAILURE CAUSE (continued)

FAILURE MODE	INDICATIONS	FAILURE CAUSE
HIGH LOCKING VELOCITY (CONTINUED)	IMPROPER TEST	TESTING
	FLUID VISCOSITY CHANGE	ENVIRONMENT
	INCORRECT FLUID	MAINTENANCE
	INADEQUATE PURGE	MAINTENANCE
HIGH BLEED RATE	AIR IN FLUID	MAINTENANCE
	INTERNAL SEAL BY-PASS	MAINTENANCE OR MANUFACTURE
	CLOGGING DURING CALIBRATION	MAINTENANCE, MANUFACTURE, UNKNOWN OR TESTING
	FIELD TAMPERING	MAINTENANCE
	IMPROPER INITIAL SETTING	MAINTENANCE
	HIGH TEST TEMPERATURE	TESTING
	IMPROPER TEST	TESTING
	FLUID VISCOSITY CHANGE	ENVIRONMENT
	INCORRECT FLUID	MAINTENANCE OR MANUFACTURE
	INADEQUATE PURGE	MAINTENANCE

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Mechanical Snubber Failure Analysis Approach, Failure Modes, Indications and Failure Cause

1.0 GENERAL

In performing any snubber analysis a full investigation should be performed prior to making any determination of the failure cause. This should be done since there may be very subtle causes, which can be masked by **NOT** performing a slow and methodical investigation. All parts should be Match Marked prior to disassembly, since the disassembly of the snubber may destroy evidence of the true cause of the snubber failure. In this approach a failure denotes a snubber **NOT** meeting its functional test acceptance criteria. The test data may show that the snubber is degraded or that it is a functional failure.

If solvents are required during the performance of the investigation, only approved solvents should be used to clean the parts.

2.0 SNUBBER LOCATION HISTORY DATA:

[1] **GIVE** a general history of the snubber location using the following as a guideline:

- Any previous functional test or visual examinations
- Snubber location in the plant
- Snubber installed orientation
- Does the snubber have a transition tube kit or a forward bracket installed? If a transition kit is installed what is the pin-to-pin dimension?
- Which end of the snubber (transition tube/forward bracket or the snubber body) is attached to the pipe?

[2] **REVIEW** any and all previously performed snubber visual examination and functional test data.

[3] **PERFORM** a field walk down of the snubber location to determine any adverse environmental conditions, such as:

- Is the snubber in a location where it could be hit, kicked or stepped upon during maintenance activities?
- Are there any signs of pipe leakage (water, steam, etc.) in the area?

2.0 SNUBBER LOCATION HISTORY DATA: (continued)

[4] **REVIEW** the piping system records to determine if any transient events have occurred in this section of piping.

[5] **REVIEW** the piping stress analysis to determine the design loading conditions of this location, the pipe support orientations, locations and the relative stiffness of the piping system. Some examples are:

- Is this location designed to take water hammer loads or other transient loads and did one occur?
- Is this location subject to pipe vibration?
- Is this location required for seismic or is it only required for operational transient loads?

[6] **REVIEW** the piping stress analyses to determine if there are other snubbers subject to the same failure mode. An example is, if a snubber failure occurred on the "A" loop is there a similar location on the "B" loop?

[7] **CHECK** the environmental data for the snubber location:

- Harsh or mild environment
- Temperature range
- Radiation dose
- Humidity

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3.0 EXTERNAL SNUBBER EVALUATION FOR ALL SIZE PSA SNUBBERS:

In almost every case, the evaluation performed on the exterior of the snubber can give clues to the nature of the failure. Following are some things which should be looked at and evaluated during the snubber evaluation.

[1] **RECORD** the following data:

- Snubber size
- Snubber serial number
- Year of manufacture
- Manufacturer's part number
- Evaluation date

[2] **CHECK** the condition of the spherical bearing on both ends of the snubber:

NOTE
A bound or "frozen" spherical bearing can put unanalyzed forces into the snubber during thermal movements, causing internal stress or damage.

- Can they be moved by hand?
- Do they "squeak" when they are moved?
- Is there foreign material on the bearings?
- Are they rusty?
- Are the spherical bearings staked in place?
- Any signs of deformation?

[3] Is there any physical damage to the snubbers' externals:

- Ding marks on exterior surfaces
- Welding arc marks on exterior surfaces

3.0 EXTERNAL SNUBBER EVALUATION FOR ALL SIZE PSA SNUBBERS: (continued)

[4] Are there any foreign materials on the exterior of the snubber? If so, would they interfere with the operation of the snubber?

- Duct tape
- Insulation materials
- Corrosion products
- Dirt or debris
- Paint or other coatings

[5] **CHECK** the external surfaces of the snubber for any signs of discoloration due to excessive temperatures.

[6] **FULLY EXTEND** the snubber, if possible, and **DENOTE** any wear or other types of marks found. The location and measurement (length, width and direction) of these marks and the actual snubber orientation during operation can be a vital clue as to what was happening to the snubber during operation.

One important aspect is to determine exactly what the snubber settings were prior to the failure and what the snubber settings were at the time of the failure. Some utilities perform snubber measurements from a fixed point on the snubber.

These measurements are recorded during the visual examinations, as well as, being documented in the Work Orders (WO) that remove the snubber from the piping system. These measurements are usually documented to the nearest 1/32nd of an inch. The importance of these measurements is that the evaluator can measure any wear marks found on the snubber and correlate the location and lengths of these wear marks to the actual snubber settings. This information can aid the evaluator in determining if these wear marks are due to the normal snubber movements (cold or hot setting) or due to vibration in either the hot or cold position.

[7] **CHECK** the retainer ring at the housing to ensure that it was installed correctly (flat side down).

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3.0 EXTERNAL SNUBBER EVALUATION FOR ALL SIZE PSA SNUBBERS: (continued)

[8] **CHECK** the connection of the transition tube kit or the forward bracket to the snubber.

- Is the tie wire intact?
- Has the transition tube loosened from the backing plate?

[9] **SLOWLY STROKE** the snubber by hand, if possible.

- **ORIENT** the snubber, as best as possible, to the orientation that the snubber was in the field prior to stroking.
- **RECORD** any rough spots and the location (stroke location).
- **RECORD** any noises heard.
- Did the snubber stroke under its own weight or was force needed to be applied to stroke the snubber? Was the applied force excessive?
- Did the snubber "stick" at any point in the stroke?
- Did any rough spots in the stroke correspond to any mark locations?

[10] **MATCH MARK** the transition tube kit or forward bracket to the snubber body and remove the transition tube kit or forward bracket.

Throughout the disassembly process, all parts should be checked for any signs of contamination, damage or wear.

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4.0 INTERNAL SNUBBER EVALUATION FOR ALL SIZE PSA SNUBBERS:

4.1 General

[1] Contamination has most notably been caused by wear products due to internal friction between the parts. A very fine reddish brown colored substance found on the internal parts may be due to fretting corrosion due to a vibration concern. This reddish brown colored substance has the consistency of a fine dust and is usually found throughout the snubber during disassembly. This substance can contaminate the lubricant causing it to dry out or become sticky.

[2] The following are areas of notable wear, all contacting surfaces should be examined thoroughly:

- The inner tube rubbing against the outer tube on the PSA-1/4 and -1/2. The position indicating tube and the support cylinder on the PSA-1, -3, and -10.
- The brass bearing of the rod and bearing assembly rubbing against the inside surface of the Inner Tube on the PSA-1/4 and -1/2.
- All faces and surfaces of the capstan spring and keeper rings on all size snubbers.
- The rods of the rod and bearing assembly rubbing against the “ears” of the guide plate on PSA-1/4 and -1/2.
- Telescoping cylinder against the support cylinder on PSA-1, -3 and -10.
- Inertia mass rubbing against the housing on all sizes.

[3] Other forms of contamination (i.e., dirt, debris, broken parts and corrosion particles) have also been seen frequently during disassembly. The location, amount and form of contamination should be noted throughout the disassembly process.

[4] During disassembly the lubricant should be checked in all accessible areas.

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4.1 General (continued)

[5] It is suggested that "surgeons" gloves be worn during disassembly. Parts (i.e., the shaft of the torque carrier and shaft assembly) can be rolled on the gloves so the tracks of the lubricant can be seen.

- Is the lubricant moist?
- Is the lubricant dried out and/or contaminated?
- Does the lubricant "track" when the part is rolled over something?
- Check the color of the lubricant. Is it reddish brown? Is it reddish black? Is it black?
- Feel the lubricant. Does it still have its lubricating properties? Is it dried out? Does it feel gritty like it is contaminated?
- Is the amount of lubricant excessive?

[6] Prior to disassembling the PSA-1/4 and -1/2 snubber, hold the snubber in a horizontal position up next to your ear and shake the snubber back and forth. A slight "clicking" noise should be heard indicating the snubber internals have some "free play".

- If no sound is heard, the snubber internals may be bound or the pivot bearing may **NOT** have been torqued properly (too tight).
- If excessive noise is heard, the pivot bearing may **NOT** have been torqued properly (too loose).

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4.1 General (continued)

[7] **SLOWLY STROKE** the snubber by pulling straight up on the end plug. With the snubber stroked fully in the tension direction, **SLIDE** the outer tube up to the end plug.

- Does the outer tube align with the end plug? If **NOT**, are the rods of the rod and bearing assembly bent?
- Are the rods of the rod and bearing assembly twisted?
- Twisted rods are normally an indication of mishandling during installation.
- Are the rods of the rod and bearing assembly bowed?
- Rods that are "bowed" outward or inward are usually a sign of a compressive overload.
- Does the outer tube slide easily over the inner tube?
- The outer tube should slide easily over the inner tube with little to no resistance. If **NOT**, is there foreign material, corrosion or debris between the inner and outer tubes?

[8] Look at the internals of the snubber down through the inner tube. Is there any contamination or degradation?

- Is the pivot bearing intact?
- PSA put a small dab of white paint on the jam nut of the pivot bearing to mark the fact that the jam nut was torqued. Excessive amounts of this white paint have been found in snubbers. This white paint has been found on the rods of the rod and bearing assembly. When this paint comes in contact with the guide plate it will cause the drag loads to increase up to the point of stalling the test bench.
- Is the anti-rotation key intact?
- Is the guide plate retaining ring intact?

[9] **SLOWLY COMPRESS** the snubber to its fully retracted position.

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4.2 PSA-1/4 and -1/2 Snubber Housing and Insert Assembly Evaluation:

[1] Removing the housing and insert assembly:

[2] **STAND** the unit vertically on the housing and insert assembly and **REMOVE** the retaining ring holding the outer tube to the housing and insert assembly.

[3] Keep a gentle pressure on the snubber and **TURN** the snubber upside down so the housing and insert assembly is pointing upwards. **SLOWLY LIFT** the housing and insert assembly from the snubber.

- Care should be taken **NOT** to lose the ball from the housing and insert assembly. The ball usually sticks in the insert assembly or to the end of the shaft.
- Did the ball stick to the end of the shaft or did it stick in the insert area of the housing and insert assembly?
- **INSPECT** the lubricant on the ball.
- **CLEAN** and **INSPECT** the ball. **USE** a magnifying glass.
- **INSPECT** the inside of the housing and insert assembly.
- Is there any lubricant in the insert area of the housing and insert assembly.
- **CLEAN** the housing and insert assembly and **USE** a magnifying glass to **INSPECT** the insert area for damage or contamination.

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4.3 PSA-1/4 and -1/2 Snubber Inertia Mass Evaluation:

[1] Prior to removing or touching the inertia mass **PERFORM** the following:

- **INSPECT** the outsides for any contamination or damage. If there are wear marks on the outside surface, **CHECK** the inside of the housing and insert assembly for a corresponding wear mark. Was the inertia mass hitting the inside of the housing?
- **CHECK** the tip of the shaft to see if it is bent, nicked or "mushroomed".
- **CHECK** the washers. Are they shiny from wear? Are they bent?
- **CHECK** the lubricant at the hole area of the inertia mass. Is it contaminated?
- **CHECK** that the capstan spring tangs are captured in the opened area of the clutch spring.
- **CHECK** for deformed or damaged washers on the shaft.
- Can the washers be easily removed?

[2] **REMOVE** and **INSPECT** the washers.

- Damaged washers could be a sign of a snubber overload.

[3] **REMOVE** the inertia mass and **PERFORM** the following:

- **NOTE** whether the inertia mass came off the shaft easily or if force had to be used to remove it from the shaft.
- **INSPECT** the inside surfaces of the inertia mass.
- **NOTE** any contamination or damage.

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4.4 PSA-1/4 and -1/2 Snubber Clutch Spring Evaluation:

[1] Prior to removing the clutch spring, **INSPECT** it to ensure that it was installed properly (fully seated in the inertia mass).

- A disengaged clutch spring can cause the snubbers acceleration test to be unacceptable if one or both of the capstan spring tangs are **NOT** captured.

[2] **REMOVE** and **INSPECT** the clutch spring.

- Are there any marks or indentations on the clutch spring where the capstan spring tangs had contacted it?
- Are there any signs of contamination?

4.5 PSA-1/4 and -1/2 Snubber Torque Carrier and Shaft Assembly Evaluation:

[1] Before removing the torque carrier and shaft assembly, **CHECK** the lubricant on the tip of the compression side of the shaft.

- **SLOWLY REMOVE** and then **INSPECT** the torque carrier and shaft assembly.
- **CHECK** the lubricant on the shaft.
- **INSPECT** the compression and tension side ends of the shaft.
- The ends of the shaft of the torque carrier and shaft assembly are "cupped". It is very important to inspect these ends for wear or damage. Use a magnifying glass. Damaged ends of the shaft could cause the shaft to bind in the insert area of the housing and insert assembly or in the pivot bearing. If the cupped ends are "mushroomed", the shaft may have been subjected to an overload.
- **CHECK** the run-outs on the shaft in three places: At the torque carrier, at mid span and at the tension side end.

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4.6 PSA-1/4 and -1/2 Snubber Capstan Spring Evaluation:

[1] Prior to removing the capstan spring, mark it so you can tell which side was toward the tension side of the shaft. A "Sharpie" marker works good. **DRAW** an arrow on the capstan spring pointing to the tension side of the shaft.

- Wear on the capstan spring tangs and the faces of the capstan spring, that contact the keeper rings, can give evidence of a normal operating snubber or one that has been subjected to piping vibration.
- **CHECK** that the keeper rings are installed properly. Improper installation of the keeper rings could cause the capstan spring to be "cocked". This could lead to the capstan spring binding on the capstan area of the inner tube. This would lead to high drag loads during the functional test.
- **REMOVE** the outer keeper ring and **REMOVE** the capstan spring. **ENSURE** that you know what side of the keeper was contacting the capstan spring.
- **INSPECT** the outside surface, the inside surface, the faces that contact the keeper rings and especially the "tang" areas of the capstan spring for wear or damage.
- **NOTE** excessive wear on the capstan spring surfaces, especially at the "tang" areas. Wear in these areas may be an indication of a piping vibration concern.
- Is the inside "running" surface of the capstan spring greasy or dry?

4.7 PSA 1/4 and 1/2 Snubber Rod and Bearing Assembly Evaluation:

[1] **ROTATE** the rod and bearing assembly to disengage the anti-rotation key and **REMOVE** the anti-rotation key.

[2] **REMOVE** the retaining ring that holds the rod and bearing assembly to the inside of the inner tube and **REMOVE** the rod and bearing assembly.

- **INSPECT** the rod and bearing assembly for any signs of contamination or degradation.
- **TAKE** run-outs on the rod and bearing assembly.

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4.8 PSA-1/4 and -1/2 Snubber Inner and Outer Tube Evaluation:

[1] **INSPECT** the internals of the inner tube and outer tube for any signs of contamination or degradation.

4.9 PSA-1/4 and -1/2 Snubber Pivot Bearing, Jam Nut and Lock Washer Evaluation:

[1] **REMOVE** and **INSPECT** the pivot bearing, jam nut and lock washer. **NOTE** any areas of excessive wear, contamination or any damaged parts.

5.0 PSA-1, -3, -10, -35 AND -100 POSITION INDICATOR TUBE, FILISTER HEAD SCREWS AND FLAT WASHERS EVALUATION:

[1] **REMOVE** the Filister head screws, flat washers and position indicator tube.

- **CHECK** the inside surface of the Indicator tube for contamination and wear markings and debris.
- **CHECK** the Filister head screws for damaged threads.

6.0 PSA-1, -3, -10, -35 AND -100 HOUSING EVALUATION:

[1] Removing the housing from the snubber internals:

[2] **STAND** unit up vertically on the housing and **REMOVE** the retaining ring holding the outer tube to the housing.

- **INSPECT** the retaining ring.

[3] Keep gentle pressure on the housing while lifting the snubber with its internals from the housing.

- **INSPECT** the inside of the housing.
- Is there any contamination or degradation? Look for internal rust, corrosion, loose debris and broken parts. Are there signs of wear due to the inertia mass contacting the housing?
- **CHECK** the dust cover for signs of impingement. Indent marks on the center of the dust cover are a sign that the shaft impacted the dust cover. This is a sign of overload.

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7.0 PSA-1, -3, -10, -35 AND -100 INTERNAL EVALUATION:

7.1 PSA-1, -3, -10, -35 and -100 Inertia Mass Evaluation:

[1] Prior to removing or touching the inertia mass **PERFORM** the following:

- **INSPECT** the outside for any contamination or damage. If there are wear marks on the outside surface, **CHECK** the inside of the housing and insert assembly for a corresponding wear mark. Was the inertia mass hitting the inside of the housing?
- **CHECK** the tip of the shaft to see if it is bent, nicked or "mushroomed".
- **CHECK** the washers. Are they shiny from wear? Are they bent?
- **CHECK** the lubricant at the hole area of the inertia mass. Is it contaminated?
- **CHECK** that the capstan spring tangs are captured in the opened area of the clutch spring.
- **CHECK** for deformed or damaged washers on the shaft.
- Can the washers be easily removed?

[2] **REMOVE** and **INSPECT** the washers.

- Damaged washers could be a sign of a snubber overload.

[3] **REMOVE** the inertia mass and **PERFORM** the following:

- **NOTE** whether the inertia mass came off the shaft easily or if force had to be used to remove it from the shaft.
- **INSPECT** the inside surfaces of the inertia mass.
- **NOTE** any contamination or damage.

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7.2 PSA-1, -3, -10, -35 and -100 Clutch Spring Evaluation:

[1] Prior to removing the clutch spring, **INSPECT** it to ensure that it was installed properly (fully seated in the inertia mass).

- A disengaged clutch spring can cause the snubbers acceleration test to be unacceptable if one or both of the capstan spring tangs are **NOT** captured.

[2] **REMOVE** and **INSPECT** the clutch spring.

- Are there any marks or indentations on the clutch spring where the capstan spring tangs had contacted it?
- Are there any signs of contamination?

7.3 PSA-1, -3, -10, -35 and -100 Torque Drum (Carrier) Evaluation:

[1] Prior to removing the torque drum (carrier), **INSPECT** the outside surfaces for contamination or degradation.

[2] **INSPECT** the flat washers and retaining ring for signs of contamination or degradation.

7.3 PSA-1, -3, -10, -35 and -100 Torque Drum (Carrier) Evaluation: (continued)

[3] **REMOVE** the flat washers, retaining ring and torque drum and **PERFORM** the following:

- **NOTE** whether the torque drum (carrier) came off the shaft easily or if force had to be used to remove it from the shaft.
- **INSPECT** the inside surfaces of the torque drum (carrier).
- **NOTE** any contamination or damage.
- **CHECK** the washers. Are they shiny from wear? Are they bent?
- **CHECK** the lubricant at the hole area of the torque drum. Is it contaminated or dried out?
- **CHECK** for deformed or damaged washers.
- Can the washers be easily removed?
- **REMOVE** and **INSPECT** the retaining ring and washers from the ball screw and shaft.
- **CHECK** the lubrication on all removed parts.
- **CHECK** lubricant on the washers.
- Are the washers damaged? Damaged washers could be a sign of an overload.

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7.4 PSA-1, -3, -10, -35 and -100 Capstan Spring Evaluation:

[1] Prior to removing the capstan spring, **MARK** it so you can tell which side was toward the tension side of the shaft. A "Sharpie" marker works good. **DRAW** an arrow on the capstan spring pointing to the tension side of the shaft.

- Wear on the capstan spring tangs and the faces of the capstan spring, that contact the keeper rings, can give evidence of a normal operating snubber or one that has been subjected to piping vibration.

[2] **CHECK** that the keeper rings are installed properly. Improper installation of the keeper rings could cause the capstan spring to be "cocked". This could lead to the capstan spring binding on the capstan area of the inner tube. This would lead to high drag loads during the functional test.

- **REMOVE** the outer keeper ring and **REMOVE** the capstan spring. **ENSURE** that you know what side of the keeper was contacting the capstan spring.
- **INSPECT** the outside surface, the inside surface, the faces that contact the keeper rings and especially the "tang" areas of the capstan spring for wear or damage.
- **NOTE** excessive wear on the capstan spring surfaces, especially at the "tang" areas. Wear in these areas may be an indication of a piping vibration concern.
- Is the inside "running" surface of the capstan spring greasy or dry?

7.5 PSA-1, -3, and -10 Bearing Nut Evaluation:

[1] **REMOVE** and **INSPECT** the bearing nut. **NOTE** any signs of contamination or degradation.

[2] **DENOTE** the condition of the lubricant on the bearing nut threads.

7.6 PSA-1, -3, -10, -35 and -100 Thrust Bearing Evaluation:

[1] Prior to removing the thrust bearing, **MATCH MARK** the outer and inner races. It is important to note that the outer race is the compression side outer race.

[2] **REMOVE** the thrust bearing.

- **DOCUMENT** any wear marks found on the races. Radial "cat's eyes" markings are a sign of vibration.
- Marks that appear to be small evenly spaced dots are a sign of possible overload.

[3] **CHECK** the lubricant on all of the parts.

[4] **INSPECT** the bearing balls for the following:

- Were they installed properly?
- Were there any signs of contamination or degradation?
- What is the condition of the lubricant?

7.7 PSA-1, -3, -10, -35 and -100 End Plug Evaluation:

[1] **REMOVE** and **INSPECT** the end plug for any signs of contamination or degradation. Oil that has separated from the lubricant has been found in the end plug.

7.8 PSA-1, -3, -10, -35 and -100 Ball (Recirculating Ball) Screw and Shaft (Precision Leadscrew) Assembly Evaluation:

[1] **REMOVE** and **INSPECT** the ball (recirculating ball) screw and shaft (precision leadscrew) assembly.

[2] **CHECK** the lubricant on the shaft.

[3] Does the bearing assembly run up and down the shaft under its own weight?

[4] Does the bearing assembly run up and down the shaft under its own weight after the lubricant has been removed or redistributed?

[5] **CHECK** the shaft (precision leadscrew) threads for signs of vibration or overload.

7.9 PSA-1, -3, -10, -35 and -100 Telescoping Cylinder Evaluation:

[1] **REMOVE** and **INSPECT** the telescoping cylinder for any signs of contamination or degradation.

[2] **NOTE** the location of all areas of wear. Snubbers that are installed horizontally usually have some amount of wear due to the telescoping cylinder rubbing against the support cylinder.

7.10 PSA-1, -3, -10, -35 and -100 Support Cylinder Evaluation:

[1] **CHECK** all surfaces of the support cylinder for indications of wear, contamination or degradation.

7.11 PSA-35 and -100 Planetary and Ring Gear Evaluation:

[1] **CHECK** gears for any dents, burrs or defects on the teeth.

7.12 PSA-35 and -100 Washer Plate Evaluation:

[1] **CHECK** the washers. Are they shiny from wear? Are they bent?

[2] **CHECK** for deformed or damaged washers.

[3] Can the washers be easily removed?

[4] **REMOVE** and **INSPECT** the washers.

- A damaged washer could be a sign of a snubber overload.

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8.0 MECHANICAL SNUBBER FAILURE MODES, INDICATIONS AND FAILURE CAUSE

FAILURE MODE	INDICATIONS	FAILURE CAUSE
HIGH DRAG	BENT SCREW SHAFT	OVER LOAD OR TRANSIENT
	INERTIA MASS TOUCHING DUST COVER	OVER LOAD OR TRANSIENT
	FOREIGN MATERIAL ON SCREW SHAFT	ENVIRONMENT
	FOREIGN MATERIAL ON INDICATOR TUBE	ENVIRONMENT
	CRACKED THRUST BEARING	OVER LOAD OR TRANSIENT
	DRY LUBRICANT	ENVIRONMENT
	CORROSION OF TORQUE DRUM	ENVIRONMENT
	CORROSION OF CAPSTAN SPRING	ENVIRONMENT
	ROUGH SPOTS ON PLANETARY GEARS	MAINTENANCE
	THRUST BEARING FRETTING	OVER LOAD OR TRANSIENT
	CAPSTAN SPRING WOUND TOO TIGHT	MANUFACTURE
	BINDING OF TELESCOPING MEMBERS	OVER LOAD OR TRANSIENT
	LOOSE BEARING RETAINER NUT	MANUFACTURE
	TELESCOPIC MEMBERS NOT CONCENTRIC	MANUFACTURE
	WELD SPATTER ON INDICATOR TUBE	MAINTENANCE
	BENT GUIDE RODS	OVER LOAD OR TRANSIENT
	FLAKED PLATING ON MOVING PARTS	MANUFACTURE
	BROKEN TEETH	OVER LOAD OR TRANSIENT
	FLATTENED BALLS	OVER LOAD OR TRANSIENT
	MISMATCHED BALLS AND BALL NUT	MANUFACTURE
	UNKNOWN	UNKNOWN

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8.0 MECHANICAL SNUBBER FAILURE MODES, INDICATIONS AND FAILURE CAUSE (continued)

FAILURE MODE	INDICATIONS	FAILURE CAUSE
ACCELERATION OR HIGH VELOCITY	CAPSTAN SPRING TOO LOOSE	MANUFACTURE
	CAPSTAN SPRING NOT INSTALLED PROPERLY	MANUFACTURE
	WORN CAPSTAN SPRING	OVER LOAD OR TRANSIENT
	KEEPER RING NOT INSTALLED CORRECTLY	MANUFACTURE
	EXCESSIVE LUBRICANT ON TORQUE DRUM	MANUFACTURE
	LUBRICANT ON INERTIA MASS	MANUFACTURE
	BENT CLUTCH TANG	MANUFACTURE
	FRACTURED BALL SCREW SHAFT	OVER LOAD OR TRANSIENT
	LOCKED DUE TO CORROSION	ENVIRONMENT
	LOCKED DUE TO INTERNAL DAMAGE	ENVIRONMENT
	BROKEN FREE	ENVIRONMENT

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Snubber Request for Relief 2-ISI-13

This relief request was approved by the NRC. Refer to 2-SI-4.6.G for details related to this request.

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Snubber Request for Relief 1-ISI-18

This Unit 1 Relief Request was approved by the NRC. Refer to 1-SI-4.6.G for details related to this request.

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Snubber Program Notebook Table of Contents

(Example)

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D4 Refueling Outage Mode 4 Restraint Actions

D5 Refueling Outage Final Snubber Reports / Critiques

E1 Program Related Technical Requirements / Commitments

E2 Program Related NER, OE, & INPO Documents

E3 Program Related PERs

E4 Program Related NRC Letters, SER, Nuregt's & LER's

E5 Program Related ASME Section XI Documents

E6 Program Related Incident Investigation & Employee Concerns Reports

E7 Program Related Assessments

E8 Program Related QDCN's and QIR's

E9 Program Related TVA Correspondence

F1 Training

G1 Snubber Spare Parts Inventory

G2 Program Service Contracts (Active & Inactive)

G3 API/Barker Snubber Test Bench

H1 Snubber Users Group (SNUG)

J1 Miscellaneous

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Snubber Request for Relief Summary

The following Table provides the status of relief requests related to snubbers. Refer to 1-SI-4.6.G, 2-SI-4.6.G, and 3-SI-4.6.G for additional information related to these Requests for Relief.

1-ISI-18	Alternate Testing Requirement for Snubbers	Approved 4/2/09 TAC# MD 8797
2-ISI-13	Alternate Testing Requirement for Snubbers	Approved 1/7/03 TAC# MB6596
3-ISI-2	Alternate Testing Requirement for Snubbers	Approved 12/22/06 TAC# MC8786

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Lisega Type 30 Hydraulic Snubbers

Lisega Type 30 Hydraulic Snubbers have been installed in Unit 2 and 3. Refer to 2-SI-4.6.H-1 and 3-SI-4.6.H-1, Visual Examination of Hydraulic and Mechanical Snubbers, for the specific installations and the visual inspection criteria. Refer to 0-SI-4.6.H-2F, Functional Testing of Lisega Type 30 Hydraulic Snubbers, for the functional testing of these snubbers.

Tennessee Valley Authority
Browns Ferry Nuclear Plant, Unit 2

Relief Request No. 2-ISI-40, Snubbers Inspection and Testing

Relief Request No. 2-ISI-40, Reference C

Browns Ferry Nuclear Plant, Surveillance Instruction, 2-SI-4.6.H-1,
"Visual Examination of Hydraulic and Mechanical Snubbers"

Browns Ferry Nuclear Plant

Unit 2

Surveillance Instruction

2-SI-4.6.H-1

Visual Examination of Hydraulic and Mechanical Snubbers

Revision 0033

Quality Related

Level of Use: Continuous Use

Effective Date: 09-21-2010

Responsible Organization: DEC, Design Eng Civil

Prepared By: Stephen Samaras

Approved By: Eric J Frevold

Current Revision Description

Pages Affected: Coversheet, Revision Description, 7, 41, 46

Type of Change: Revision Tracking Number: 034

This revision is to add signoffs and calibration accuracy ranges for M & TE calibrated measurement test equipment and pyrometers as identified by PER 236306. Revised Section 5.0 and Attachment 9.

Table of Contents

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1.0 INTRODUCTION

1.1 Purpose

This Surveillance Instruction implements Technical Requirements Manual (TRM) TR 3.7.4, and provides direction for the visual examination of hydraulic and mechanical snubbers, as given in the Snubber Program Procedure (0-TI-398), on all safety-related systems, inside and outside of the drywell.

1.2 Scope

NOTES

1) For the purposes of this instruction, all snubbers are combined as one population. The snubbers are listed in Appendix A by the manufacturer and sizes which are required for the functional testing requirements.
2) As used in this instruction, "type of snubber" shall mean snubbers of the same design and manufacturer, irrespective of capacity.
3) The remaining portions of Technical Requirements 3.7.4 pertain to the functional testing of snubbers and are implemented by Surveillance Instructions: 0-SI-4.6.H-2A, 0-SI-4.6.H-2B, 0-SI-4.6.H-2C, 0-SI-4.6.H-2E and 0-SI-4.6.H-2F.

A. This Surveillance Instruction (SI) includes provision for as-found functional testing to establish operability of snubbers which appear inoperable as a result of the visual examination.

B. Guidance to Perform the Visual Examination

This Surveillance Instruction (SI) provides the requirements and guidance to perform the visual examinations of all snubbers for Unit 2 as follows:

1. Provides the requirements to completely fulfill the Technical Requirements Manual (TRM) visual examination of all snubbers. The interval will be as required by TR 3.7.4, Table 3.7.4-1.

2. Provides a means for the control and documentation of all snubber visual surveillance activities provided in this Surveillance Instruction.

2.0 REFERENCES

A. Technical Requirements Manual (TR 3.7.4), Snubbers.

B. 0-SI-4.6.H-2A, Functional Testing of Mechanical Snubbers.

C. 0-SI-4.6.H-2B, Functional Testing of Bergen-Paterson, Anchor/Darling, Fronek Hydraulic Snubbers.

D. 0-SI-4.6.H-2C, Functional Testing of Bergen-Paterson Torus Dynamic Restraints.

E. 0-SI-4.6.H-2E, Functional Testing of Lisega Torus Dynamic Restraint Snubbers.

F. 0-SI-4.6.H-2F, Functional Testing of Lisega Type 30 Hydraulic Snubbers.

G. MPI-0-000-SNB002, Hydraulic Shock and Sway Arrestor Bergen-Paterson, Anchor/Darling, Fronek Unit Disassembly and Reassembly.

H. MPI-0-000-SNB004, Instructions for Removing and Reinstalling Pacific Scientific Mechanical, Bergen-Paterson, Anchor/Darling, Fronek, Lisega Type 30 Hydraulic, and Bergen-Paterson or Lisega Torus Dynamic Snubbers.

I. 0-TI-398, Snubber Program Procedure

J. SPP-3.1, Corrective Action Program

K. SPP-8.1, Conduct of Testing

3.0 PRECAUTIONS AND LIMITATIONS

None

4.0 PREREQUISITES

None

5.0 SPECIAL TOOLS AND EQUIPMENT RECOMMENDED

A. Length Measuring Scales, M&TE Measuring Test Equipment (to an accuracy of ± 0.01 inches) for Torus Restraints

B. Inspection Mirrors, as required

C. GE SF 1154 Silicon Fluid, as required (To be used for all snubbers except the LISEGA Torus Dynamic Restraints and LISEGA Type 30 small bore snubbers).

D. LISEGA AP-280 Silicon Fluid, as required (To be used only for LISEGA Torus Dynamic Restraints and LISEGA Type 30 small bore snubbers).

E. Calibrated Thermometer (to an accuracy of ± 2°F) and M&TE Measuring Test Equipment for Bergen-Paterson Torus Restraints

6.0 ACCEPTANCE CRITERIA

Responses which fail to meet the following acceptance criteria require immediate notification of the Snubber Engineer/SE Designee at the time of failure.

A. Visual examinations shall verify:

1. The snubber has no visible indications of damage or impaired operability.
2. Attachments to the foundation or supporting structure are functional.
3. Fasteners for the attachment of the snubber to the component or system and to the snubber anchorage are functional. The discovery of loose or missing attachment fasteners will be evaluated to determine whether the cause may be localized or generic.
4. The snubber has the proper orientation, and adequate fluid level, if applicable.

7.0 PROCEDURE STEPS

7.1 Training and Qualifications of Performers

7.1.1 Visual Examinations

A. A thorough briefing should be conducted on SI performance prior to starting.

B. The performer or cognizant individual responsible for the performance of the Surveillance Instruction must be task qualified.

C. Appropriate General Employee Training (GET) (including respirator training) should be received by the examining personnel prior to performing this SI.

D. The training for the visual examinations should include orientation to the requirements of this Surveillance Instruction and will be performed under task number MMY 501,as required.

E. Personnel performing this visual examination must meet the visual acuity requirements of ASME Section XI, 2001 Edition, 2003 Addenda, Paragraph IWA-2321.

F. Documentation shall be maintained by the Snubber Engineer for the Visual Acuity Examinations.

7.2 General Information

A. Snubbers which appear inoperable as a result of visual examination shall be classified unacceptable and may be reclassified as acceptable for the purpose of establishing the next visual examination interval, provided that:

1. The cause of the rejection is clearly established and remedied for that particular snubber and for other snubbers irrespective of type that may be generically susceptible.

2. The affected snubber is functionally tested in the as-found condition and determined OPERABLE per the as-found acceptance criteria for that snubber.

A review and evaluation shall be performed and documented in Attachment 6, 7, or 8 as applicable, to justify continued operation with an unacceptable snubber. If continued operation cannot be justified, the snubber shall be declared inoperable and the LIMITING CONDITIONS OF OPERATION (LCO) for the system shall be met.

B. Snubbers attached to sections of safety-related systems that have experienced unexpected potentially damaging transients since the last examination period shall be evaluated for the possibility of concealed damage and functionally tested, if applicable, to confirm OPERABILITY.

C. Snubbers which have been made inoperable as the result of an unexpected transient, isolated damage, or other random events, when the provisions of TSR 3.7.4.5 and 3.7.4.6 have been met and any other appropriate corrective action implemented, shall **NOT** be counted in determining the next visual examination interval.

NOTE
The snubbers may be divided into accessible or inaccessible categories, and they may be inspected together or separately. For the purpose of performing this SI, all snubbers are classified as one category.

D. A Surveillance Instruction Review Form, Attachment 1, shall be completed and submitted with the data package for each complete or partial performance of this SI.

E. All visual examinations shall be performed and documented on Attachments 2, 3, 4, 5, and 9, as applicable prior to removal of each snubber for the As-Found functional testing. The Attachments shall be submitted with the data package.

7.2 General Information (continued)

F. Evaluation sheets Attachments 6, 7, and 8 shall be prepared and submitted with the data package, as appropriate, by the Snubber Engineer/SE Designee for each degraded/inoperable snubber identified by performance of this instruction.

G. The snubbers are assigned a UNID number in an appropriate tracking program, which provides current and historical information for a specific snubber/support location.

H. The snubbers are listed in Appendix A by exam number.

I. A unique snubber/support number is given to each snubber location on a system.

7.3 Examination Instructions, Acceptance Criteria and Data Entry

7.3.1 Package Preparation and Evaluation

NOTES

1) The operability of the snubber is determined based on the examinations performed and further evaluations which may include a functional test. If it is determined that the snubber does **NOT** meet the visual examination acceptance criteria, immediately notify the Snubber Engineer/SE Designee.
2) If further evaluations, which may include a functional test, are acceptable, the snubber is operable.
3) The snubber is **NOT** counted as inoperable, and the examination interval is **NOT** shortened, if the snubber is proven operable by the functional test.

[1] If any snubber is determined to be inoperable, Site Engineering Civil should INITIATE a Problem Evaluation Report (PER). MMG Planning should write a minor maintenance Work Order (WO) to perform the necessary repairs required to return the inoperable snubber to operable status.

[2] At the discretion of the Snubber Engineer/SE Designee, **FUNCTIONALLY TEST** snubbers which appear to be inoperable by visual examination to establish operability if the unacceptable indication relates to the internal functioning of the snubber. This shall be documented on Attachment 7 or 8, as appropriate.

[3] Functional tests shall be performed in accordance with 0-SI-4.6.H-2A, -2B, -2C, -2E, or -2F.

[4] **NOTIFY** Site Engineering Civil to perform an engineering evaluation for any inoperable snubber.

[5] An "AC", "UNAC", or "N/A" entry must be provided in the appropriate space, on Attachments 2, 3, 4, or 5, as appropriate, for every snubber scheduled for examination per this SI.

[6] **VERIFY** Attachment 1, 2, 3, 4, 5, and other appropriate Attachments, have been reviewed by the Snubber Engineer/SE Designee from Site Engineering Civil, prior to closure of this Surveillance Instruction.

7.3.2 Data Sheet Review

[1] **VERIFY** any Work Orders have been satisfactorily completed and PERs have had the corrective actions completed or closed.

[2] **VERIFY** that all applicable Attachments are complete for the snubber being visually examined.

[3] **VERIFY** failure analysis of inoperable snubber(s) has been completed, as required.

[4] **VERIFY** the Site Engineering Civil evaluation for the supported system/component analysis, from the appropriate functional test procedure for inoperable snubber(s), has been completed and is acceptable.

[5] **VERIFY** that the evaluation of loose or missing attachment fasteners has been completed, if required.

[6] **VERIFY** the Snubber Engineer or SE-Designee has reviewed all appropriate Attachments 2, 3, 4, 5, 6, 7, 8, and 9.

8.0 ILLUSTRATION/ATTACHMENTS

Appendix A, Snubber Listing.

Attachment 1, Surveillance Instruction Review Form.

Attachment 2, Snubber Visual Examination Checklist For All Snubbers.

Attachment 3, Snubber Visual Examination Checklist For Bergen-Paterson, Anchor/Darling, Fronek Hydraulic Snubbers.

Attachment 4, Snubber Visual Examination Checklist For Lisega Torus Dynamic Restraint Hydraulic Snubbers.

Attachment 5, Snubber Visual Examination Checklist for Lisega Type 30 Hydraulic Snubbers

Attachment 6, Evaluation of Loose or Missing Attachment Fasteners.

Attachment 7, Engineering Evaluation of Unacceptable Indication.

Attachment 8, Engineering Evaluation of Transient Event Indication and Effect.

Attachment 9, BERGEN-PATERSON Torus Dynamic Restraint Fluid Level Check.

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Snubber Listing

EX	SUPPORT #	SNUBBER DWG #	UNID #	TYPE/SIZE	LOCATION	ISI DWG #	Scaffold Required For Visual	Scaffold Required For Functional Test
1	2-47B451R0033	47B451R0033	2-SNUB-067-5001	HSSA 3	Core Spray Platform ELEV. 606	0-ISI-0368-C (6 OF 15)	N	N
2	RHR R-94W	47B452-995	2-SNUB-074-5055	PSA 35	Clean Room ELEV. 565, @ FCV-74-52	2-ISI-0324-C (8 OF 13)	N	N
3	RHR R-94N	47B452-995	2-SNUB-074-5056	PSA 35	Clean Room ELEV. 565, @ FCV-74-52	2-ISI-0324-C (8 OF 13)	N	N
4	RHR R-61L	47B452-1199	2-SNUB-074-5029	ADH 3	R-12 & S-LINE ELEV. 597, @ FCV-74-74		N	N
5	RHR R-61U	47B452-1199	2-SNUB-074-5028	HSSA 3	R-12 & S-LINE ELEV. 599, @ FCV-74-74		N	N
6	RHR H-62	47B452-418	2-SNUB-074-5032	HSSA 10	R-12 & S-LINE ELEV. 601, @ FCV-74-74	2-ISI-0324-C (11 OF 13)	N	N
7	RHR R-158N	47B452-416	2-SNUB-074-5030	HSSA 3	R-12 & S-LINE ELEV. 595, @ FCV-74-74	2-ISI-0324-C (11 OF 13)	N	N
8	RHR R-158S	47B452-416	2-SNUB-074-5031	ADH 3	R-12 & S-LINE ELEV. 595, @ FCV-74-74	2-ISI-0324-C (11 OF 13)	N	N
17	CS R-33	47B458-198	2-SNUB-075-5025	PSA 35	NW QUAD CS PMP RM ELEV. 538		Y	Y
18	RCIC R-27NE	47B456-51-1	2-SNUB-071-5001	PSA 35	NW QUAD CS PMP RM ELEV. 538	2-ISI-0131-C (1 OF 1)	N	Y
19	RCIC R-27SW	47B456-51-1	2-SNUB-071-5002	PSA 35	NW QUAD CS PMP RM ELEV. 538	2-ISI-0131-C (1 OF 1)	N	Y
20	RCIC R-28	47B456-52	2-SNUB-071-5003	PSA 3	NW QUAD, Top of Missile Shield, ELEV. 534	2-ISI-0131-C (1 OF 1)	N	N
21	RCIC R-4N	47B456-116	2-SNUB-071-5004	HSSA 3	NW QUAD, @ CKV-71-499, ELEV. 528	2-ISI-0131-C (1 OF 1)	Y	Y
22	RCIC R-4S	47B456-116	2-SNUB-071-5005	ADH 3	NW QUAD, @ CKV-71-499, ELEV. 528	2-ISI-0131-C (1 OF 1)	Y	Y
23	2-47B456R005E	2-47B456R0005	2-SNUB-071-5007	HSSA 3	NW QUAD EXHAUST LINE ELEV. 538		L	Y
24	2-47B456R005S	2-47B456R0005	2-SNUB-071-5006	HSSA 3	NW QUAD EXHAUST LINE ELEV. 538		L	Y
25	2-47B462S0025	2-47B462S0025	2-SNUB-063-5001	HSSA 3	R11-R12 & P-LINE ELEV 626		N	L
26	2-47B452S0152	2-47B452S0152	2-SNUB-074-5025	PSA 10	RHR HT EX RM A&C ELEV. 571, NEAR HCV-74-10	2-ISI-0324-C (5 OF 13)	N	N
27	2-47B452R0060E	2-47B452R0060	2-SNUB-074-5026	PSA 3	RHR HT EX RM A&C ELEV. 571, @ HCV-74-22	2-ISI-0324-C (5 OF 13)	N	N
28	2-47B452R0060W	2-47B452R0060	2-SNUB-074-5027	PSA 3	RHR HT EX RM A&C ELEV. 571, @ HCV-74-22	2-ISI-0324-C (5 OF 13)	N	N
29	RHR R-10	2-47B452-451	2-SNUB-074-5045	HSSA 20	TOP OF TORUS, BAY 13, ELEV. 556	2-ISI-0324-C (9 OF 13)	N	N
30	CS R-68	47B458-461,	2-SNUB-075-5026	PSA 35	NE QUAD CS PUMP TEST LINE ELEV. 540		Y	Y
31	2-47B452S0289E	2-47B452S0289	2-SNUB-074-5033	PSA 10	RHR HT EX RM B&D ELEV.572, @ HCV-74-44	2-ISI-0324-C (7 OF 13)	N	Y
32	2-47B452S0289W	2-47B452S0289	2-SNUB-074-5034	PSA 10	RHR HT EX RM B&D ELEV.572, @ HCV-74-44	2-ISI-0324-C (7 OF 13)	N	Y
33	2-47B452S0252	2-47B452S0252	2-SNUB-074-5035	PSA 10	RHR HT EX RM B&D ELEV.571, @ FCV-74-33	2-ISI-0324-C (7 OF 13)	N	N
34	2-47B452R0054	2-47B452R0054	2-SNUB-074-5017	HSSA 10	RHR PUMP RM B&D ELEV. 531	2-ISI-0324-C (6 OF 13)	Y	Y
35	2-47B452S0245	2-47B452S0245	2-SNUB-074-5018	HSSA 10	RHR PUMP RM B&D ELEV. 539	2-ISI-0324-C (6 OF 13)	Y	Y
36	2-47B452S0246	2-47B452S0246	2-SNUB-074-5019	PSA 10	RHR PUMP RM B&D ELEV. 538	2-ISI-0324-C (6 OF 13)	Y	Y
37	2-47B452R0056	2-47B452R0056	2-SNUB-074-5020	PSA 10	RHR PUMP RM B&D ELEV. 534	2-ISI-0324-C (6 OF 13)	Y	Y

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EX	SUPPORT #	SNUBBER DWG #	UNID #	TYPE/SIZE	LOCATION	ISI DWG #	Scaffold Required For Visual	Scaffold Required For Functional Test
38	2-47B452S0248	2-47B452S0248	2-SNUB-074-5021	PSA 10	RHR PUMP RM B&D ELEV. 540	2-ISI-0324-C (6 OF 13)	Y	Y
39	2-47B452S0247	2-47B452S0247	2-SNUB-074-5022	PSA 10	RHR PUMP RM B&D ELEV. 540	2-ISI-0324-C (6 OF 13)	Y	Y
40	RHR R-58	47B452-988	2-SNUB-074-5023	HSSA 10	R-9 & S LINE ELEV. 576, NEAR FCV-74-60		Y	Y
41	RHR R-226	47B452-987	2-SNUB-074-5054	PSA 10	R-9 & S LINE ELEV. 574, NEAR FCV-74-60		Y	Y
42	HPCI H-176U	47B455-79	2-SNUB-073-5011	PSA 35	SE QUAD HPCI RM ELEV. 540, @ CKV-73-603	2-ISI-0130-C (1 OF 3)	Y	Y
43	HPCI H-176L	47B455-79	2-SNUB-073-5012	PSA 35	SE QUAD HPCI RM ELEV. 536,@ CKV-73-603	2-ISI-0130-C (1 OF 3)	Y	Y
44	HPCI H-177U	47B455-81	2-SNUB-073-5013	PSA 10	SE QUAD HPCI RM ELEV 539, NEAR CKV-73-603	2-ISI-0130-C (1 OF 3)	Y	Y
45	HPCI H-177L	47B455-81	2-SNUB-073-5014	PSA 10	SE QUAD HPCI RM ELEV. 539, NEAR CKV-73-603	2-ISI-0130-C (1 OF 3)	Y	Y
46	2-47B415S0024	2-47B415S0024	2-SNUB-003-5033	PSA 35	DRYWELL STEAM DECK EL. 586 AZ 221	2-ISI-0277-C (1 OF 1)	N	N
47	2-47B455R0016	2-47B455R0016	2-SNUB-073-5001	PSA 3	SE QUAD HPCI RM TURB. STM SUPPLY ELEV.533	2-ISI-0130-C (1 OF 3)	Y	Y
49	2-47B456R0009N	2-47B456R0009	2-SNUB-071-5010	HSSA 3	STEAM TUNNEL ELEV.564		N	N
50	2-47B456R0009S	2-47B456R0009	2-SNUB-071-5011	HSSA 3	STEAM TUNNEL ELEV. 564		N	N
51	2-47B452R0051 N	2-47B452R0051	2-SNUB-074-5011	HSSA 3	SW QUAD RHR PUMP RM A&C ELEV. 537	2-ISI-0324-C (4 OF 13)	Y	Y
52	2-47B452R0051 S	2-47B452R0051	2-SNUB-074-5012	HSSA 3	SW QUAD RHR PUMP RM A&C ELEV. 537	2-ISI-0324-C (4 OF 13)	Y	Y
53	2-47B452R0052 N	2-47B452R0052	2-SNUB-074-5013	PSA 3	SW QUAD RHR PUMP RM A&C ELEV. 558	2-ISI-0324-C (5 OF 13)	Y	Y
54	2-47B452R0052 W	2-47B452R0052	2-SNUB-074-5014	HSSA 10	SW QUAD RHR PUMP RM A&C ELEV. 558	2-ISI-0324-C (5 OF 13)	Y	Y
55	2-47B452R0053 E	2-47B452R0053	2-SNUB-074-5016	HSSA 10	SW QUAD RHR PUMP RM A&C ELEV. 537	2-ISI-0324-C (4 OF 13)	Y	Y
56	2-47B452R0053 N	2-47B452R0053	2-SNUB-074-5015	HSSA 10	SW QUAD RHR PUMP RM A&C ELEV. 537	2-ISI-0324-C (4 OF 13)	Y	Y
57	2-47B455R0019	2-47B455R0019	2-SNUB-073-5003	HSSA 3	TOP OF TORUS, BAY 1, ELEV. 547		Y	Y
58	2-47B455R0020	2-47B455R0020	2-SNUB-073-5004	HSSA 10	TOP OF TORUS, BAY 3, ELEV. 551, NEAR FCV-73-03		Y	Y
59	2-47B452S0157	2-47B452S0157	2-SNUB-074-5008	ADH 30	TOP OF TORUS, BAY 3, ELEV. 544, @ FCV-74-46	2-ISI-0324-C (8 OF 13)	Y	Y
60	2-47B452R0020 U	2-47B452R0020	2-SNUB-074-5007	HSSA 20	TOP OF TORUS, BAY 3, ELEV. 550, @ FCV-74-46	2-ISI-0324-C (8 OF 13)	Y	Y
65	RHR R-91	2-47B452-503	2-SNUB-074-5043	PSA 3	TOP OF TORUS, BAY 5		N	N
66	RHR R-95	2-47B452-968	2-SNUB-074-5051	PSA 35	TOP OF TORUS, BAY 14, ELEV. 555	2-ISI-0324-C (9 OF 13)	N	N
67	RHR R-99	2-47B452-460	2-SNUB-074-5048	PSA 3	TOP OF TORUS, BAY 14 ELEV. 555, @ FCV-74-71	2-ISI-0324-C (9 OF 13)	N	N
68	RHR R-92	2-47B452-892	2-SNUB-074-5041	PSA 10	TOP OF TORUS, BAY 4 ELEV. 555, NEAR FCV-74-57	2-ISI-0324-C (8 OF 13)	N	N
69	RHR R-96	2-47B452-970	2-SNUB-074-5040	PSA 35	TOP OF TORUS, BAY 3, ELEV. 555, @ FCV-74-57	2-ISI-0324-C (8 OF 13)	N	N
70	RHR H-343	2-47B452-981	2-SNUB-074-5042	PSA 1	TOP OF TORUS, BAY 5 ELEV. 555, @ FCV-74-59	2-ISI-0324-C (8 OF 13)	N	N

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EX	SUPPORT #	SNUBBER DWG #	UNID #	TYPE/SIZE	LOCATION	ISI DWG #	Scaffold Required For Visual	Scaffold Required For Functional Test
71	RCIC R-29A	47B456-70	2-SNUB-071-5014	PSA 1	TOP OF TORUS, BAY 6 ELEV. 555		Y	Y
72	RCIC R-68	47B456-502	2-SNUB-071-5015	PSA 1	TOP OF TORUS, BAY 6, EL 554		Y	Y
73	RCIC R-54U	2-47B456-112	2-SNUB-071-5012	PSA 1	NW QUAD, EL. 529	2-ISI-0131-C (1 OF 1)	Y	Y
74	RCIC R-54L	2-47B456-112	2-SNUB-071-5013	PSA 1	NW QUAD, EL. 527	2-ISI-0131-C (1 OF 1)	Y	Y
75	RCIC H-192	47B455-86	2-SNUB-073-5017	PSA 1	TOP OF TORUS, BAY 13, ELEV. 554		N	Y
76	RHR R-193N	47B452-492	2-SNUB-074-5049	PSA 35	TOP OF TORUS, BAY 13, ELEV. 549		Y	Y
77	RHR R-193S	47B452-492	2-SNUB-074-5050	PSA 35	TOP OF TORUS, BAY 13, ELEV. 549		Y	Y
78	RHR R-102W	2-47B452-468	2-SNUB-074-5053	PSA 35	Clean Room, EL. 566, @ FCV-74-66	2-ISI-0324-C (9 OF 13)	N	N
79	RHR R-102N	2-47B452-468	2-SNUB-074-5052	PSA 35	Clean Room, EL. 566, @ FCV-74-66	2-ISI-0324-C (9 OF 13)	N	N
80	RHR R-105	2-47B452-461	2-SNUB-074-5044	PSA 3	TOP OF TORUS, BAY 13, ELEV. 554		N	N
81	RHR H-344N	2-47B452-983	2-SNUB-074-5046	PSA 1	TOP OF TORUS, BAY 13, ELEV. 555	2-ISI-0324-C (9 OF 13)	N	N
82	RHR H-344S	2-47B452-983	2-SNUB-074-5047	PSA 1	TOP OF TORUS, BAY 13, ELEV. 555	2-ISI-0324-C (9 OF 13)	N	N
83	HPCI H-180	47A455-390	2-SNUB-073-5016	PSA 1	TORUS PEN X-222, BAY 16, EL 538		Y	Y
84	HPCI H-182	47A455-392	2-SNUB-073-5015	PSA 1/4	SE Quad, HPCI TURB EXH. DR. EL.538		Y	Y
85	RHR R-41E	2-47B452-1206	2-SNUB-074-5009	HSSA 3	TOP OF TORUS, BAY 3, EL. 555		N	N
86	RHR R-41W	2-47B452-1206	2-SNUB-074-5010	ADH 3	TOP OF TORUS, BAY 3, EL 555		N	N
87	RHR R-19	2-47B452-454	2-SNUB-074-5006	HSSA 10	TOP OF TORUS, BAY 5, EL 555	2-ISI-0324-C (8 OF 13)	N	N
88	RHR R-194N	47B452-152	2-SNUB-074-5001	PSA 35	TOP OF TORUS, BAY 5, ELEV. 549		Y	Y
89	RHR R-194S	47B452-152	2-SNUB-074-5002	PSA 35	TOP OF TORUS, BAY 5, ELEV. 549		Y	Y
92	2-47B553S0009E	2-47B553S0009	2-SNUB-002-5003	HSSA 10	TORUS, OFF SIDE OF CATWALK, BAY 7, ELEV. 548		Y	Y
93	2-47B553R0002W	2-47B553R0002	2-SNUB-002-5004	PSA 10	TORUS, OFF SIDE OF CATWALK, BAY 7, ELEV. 548		Y	Y
94	2-47B456R0007L	2-47B456R0007	2-SNUB-071-5009	HSSA 3	TORUS, OFF SIDE OF CATWALK, BAY 8, ELEV. 547		Y	Y
95	2-47B456R0007U	2-47B456R0007	2-SNUB-071-5008	HSSA 3	TORUS, OFF SIDE OF CATWALK, BAY 8, ELEV. 546		Y	Y
96	2-47B553R0003	2-47B553R0003	2-SNUB-002-5005	HSSA 10	TORUS, OFF SIDE OF CATWALK, BAY 9, ELEV. 548		Y	Y
97	2-47B553S0010	2-47B553S0010	2-SNUB-002-5006	HSSA 10	TORUS, OFF SIDE OF CATWALK, BAY 9, ELEV. 548		Y	Y
98	2-47B553R0004	2-47B553R0004	2-SNUB-002-5007	HSSA 10	TORUS, OFF SIDE OF CATWALK, BAY 11, ELEV. 548		Y	Y
99	2-47B553S0011	2-47B553S0011	2-SNUB-002-5008	HSSA 10	TORUS, OFF SIDE OF CATWALK, BAY 11, ELEV. 548		Y	Y
100	2-47B553S0012U	2-47B553S0012	2-SNUB-002-5009	PSA 10	TORUS, OFF SIDE OF CATWALK, BAY 12, ELEV. 549		Y	Y

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EX	SUPPORT #	SNUBBER DWG #	UNID #	TYPE/SIZE	LOCATION	ISI DWG #	Scaffold Required For Visual	Scaffold Required For Functional Test
101	2-47B553S0012 L	2-47B553S0012	2-SNUB-002-5010	PSA 10	TORUS, OFF SIDE OF CATWALK, BAY 12, ELEV. 549		Y	Y
102	2-47B452S0250	2-47B452S0250	2-SNUB-074-5004	HSSA 20	SIDE OF TORUS BAY 14, ELEV. 549	2-ISI-0324-C (9 OF 13)	Y	Y
103	2-47B452S0251	2-47B452S0251	2-SNUB-074-5005	ADH 20	SIDE OF TORUS BAY 14, ELEV. 549	2-ISI-0324-C (9 OF 13)	Y	Y
104	CS R-17	47W403-14	2-SNUB-075-5001	PSA 35	PSC RING HDR, BAY 12, EL. 525		N	N
105	CS R-18	47W403-14	2-SNUB-075-5002	PSA 35	PSC RING HDR, BAY 15, EL. 525		N	N
106	CS R-19	47W403-14	2-SNUB-075-5003	PSA 35	PSC RING HDR, BAY 3, EL. 525		N	N
107	CS R-20	47W403-14	2-SNUB-075-5004	PSA 35	PSC RING HDR, BAY 6, EL. 525		N	N
108	CS R-21L	47W403-15	2-SNUB-075-5006	PSA 35	PSC RING HDR, BAY 16, EL. 525		N	N
109	CS R-21U	47W403-15	2-SNUB-075-5005	PSA 35	PSC RING HDR, BAY 16, EL.525		L	Y
110	CS R-22L	47W403-15	2-SNUB-075-5008	PSA 35	PSC RING HDR, BAY 2, EL. 525		N	N
111	CS R-22U	47W403-15	2-SNUB-075-5007	PSA 35	PSC RING HDR, BAY 2, EL. 525		L	Y
112	CS R-23L	47W403-16	2-SNUB-075-5010	PSA 35	PSC RING HDR, BAY 11, EL. 525		N	N
113	CS R-23U	47W403-16	2-SNUB-075-5009	PSA 35	PSC RING HDR, BAY 11, EL. 525		L	Y
114	CS R-24L	47W403-16	2-SNUB-075-5012	PSA 35	PSC RING HDR, BAY 16, EL. 525		N	N
115	CS R-24U	47W403-16	2-SNUB-075-5011	PSA 35	PSC RING HDR, BAY 16, EL. 525		L	Y
116	CS R-25L	47W403-16	2-SNUB-075-5014	PSA 35	PSC RING HDR, BAY 7, EL. 525		N	N
117	CS R-25U	47W403-16	2-SNUB-075-5013	PSA 35	PSC RING HDR, BAY 7, EL. 525		L	Y
118	TORUS R1	2-48W1265-1	2-SNUB-064-0001	LISEGA 312150	TORUS ROOM, BAY 1, ELEV. 526		L	Y
119	TORUS R2	2-48W1265-1	2-SNUB-064-0002	LISEGA 312150	TORUS ROOM, BAY 2, ELEV. 526		L	Y
120	TORUS R3	2-48W1265-1	2-SNUB-064-0003	LISEGA 312150	TORUS ROOM, BAY 3, ELEV. 526		L	Y
121	TORUS R4	2-48W1265-1	2-SNUB-064-0004	LISEGA 312150	TORUS ROOM, BAY 4, ELEV. 526		L	Y
122	TORUS R5	2-48W1265-1	2-SNUB-064-0005	LISEGA 312150	TORUS ROOM, BAY 5, ELEV. 526		L	Y
123	TORUS R6	2-48W1265-1	2-SNUB-064-0006	B-P 12	TORUS ROOM, BAY 6, ELEV. 526		L	Y
124	TORUS R7	2-48W1265-1	2-SNUB-064-0007	LISEGA 312150	TORUS ROOM, BAY 7, ELEV. 526		L	Y

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125	TORUS R8	2-48W1265-1	2-SNUB-064-0008	LISEGA 312150	TORUS ROOM, BAY 8, ELEV. 526		L	Y
126	TORUS R9	2-48W1265-1	2-SNUB-064-0009	LISEGA 312150	TORUS ROOM, BAY 9, ELEV. 526		L	Y
127	TORUS R10	2-48W1265-1	2-SNUB-064-0010	LISEGA 312150	TORUS ROOM, BAY 10, ELEV. 526		L	Y
128	TORUS R11	2-48W1265-1	2-SNUB-064-0011	B-P 12	TORUS ROOM, BAY 11, ELEV. 526		L	Y
129	TORUS R12	2-48W1265-1	2-SNUB-064-0012	LISEGA 312150	TORUS ROOM, BAY 12, ELEV. 526		L	Y
130	TORUS R13	2-48W1265-1	2-SNUB-064-0013	LISEGA 312150	TORUS ROOM, BAY 13, ELEV. 526		L	Y
131	TORUS R14	2-48W1265-1	2-SNUB-064-0014	LISEGA 312150	TORUS ROOM, BAY 14, ELEV. 526		L	Y
132	TORUS R15	2-48W1265-1	2-SNUB-064-0015	B-P 12	TORUS ROOM, BAY 15, ELEV. 526		L	Y
133	TORUS R16	2-48W1265-1	2-SNUB-064-0016	B-P 12	TORUS ROOM, BAY 16, ELEV. 526		L	Y
134	2-47B452R0077	2-47B452R0077	2-SNUB-074-5036	HSSA 3	R9 & T-LINE, ELEV. 578, NEAR FCV-74-100		Y	Y
135	2-47B2650-619	2-47B2650-619	2-SNUB-003-5001	PSA 1/2	DRYWELL, AZ 37, ELEV. 631		N	N
136	2-47B2650-620	2-47B2650-620	2-SNUB-003-5002	PSA 1/2	DRYWELL, AZ 37, ELEV. 631		N	N
137	2-47B2650-621	2-47B2650-621	2-SNUB-003-5003	PSA 1/2	DRYWELL, AZ 220, ELEV. 631		N	N
138	2-47B2650-622	2-47B2650-622	2-SNUB-003-5004	PSA 1/4	DRYWELL, AZ 220, ELEV. 631		N	N
139	2-47B2650-623	2-47B2650-623	2-SNUB-003-5005	PSA 1/2	DRYWELL, AZ 220, ELEV. 631		N	N
140	2-47B408S0061	2-47B408S0061	2-SNUB-068-5020	ADH 70	DRYWELL, RECIRC PMP, AZ 315, ELEV. 553	2-ISI-0278-C (1 OF 2)	N	N
141	2-47B408S0046	2-47B408S0046	2-SNUB-068-5019	ADH 50	DRYWELL, RECIRC PMP, AZ 135, ELEV. 553	2-ISI-0278-C (2 OF 2)	N	N
142	2-47B408S0063	2-47B408S0063	2-SNUB-068-5003	ADH 70	DRYWELL, RECIRC PMP, AZ 315, EL. 559	2-ISI-0278-C (1 OF 2)	L	Y
143	2-47B408S0047	2-47B408S0047	2-SNUB-068-5004	ADH 50	DRYWELL, RECIRC PMP, AZ 135, EL. 559	2-ISI-0278-C (2 OF 2)	L	Y
144	2-47B408S0062	2-47B408S0062	2-SNUB-068-5015	ADH 50	DRYWELL, RECIRC PMP, AZ 315, EL. 559	2-ISI-0278-C (1 OF 2)	L	Y
145	2-47B408S0048	2-47B408S0048	2-SNUB-068-5016	LISEGA 307256	DRYWELL, RECIRC PMP, AZ 135, ELEV. 559	2-ISI-0278-C (2 OF 2)	Y	Y
146	2-47B408S0042	2-47B408S0042	2-SNUB-068-5017	HSSA 20	DRYWELL BASEMENT, AZ 171, ELEV. 554	2-ISI-0278-C (2 OF 2)	N	N
147	2-47B408S0058	2-47B408S0058	2-SNUB-068-5018	LISEGA 30725	DRYWELL BASEMENT, AZ 358, ELEV. 554	2-ISI-0278-C (1 OF 2)	N	N

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EX	SUPPORT #	SNUBBER DWG #	UNID #	TYPE/SIZE	LOCATION	ISI DWG #	Scaffold Required For Visual	Scaffold Required For Functional Test
148	2-47B458S0004	2-47B458S0004	2-SNUB-075-5021	HSSA 10	DRYWELL STEAM DECK, AZ 230, ELEV. 605	ISI-0280-C (1 OF 1)	N	N
149	2-47B458S0005	2-47B458S0005	2-SNUB-075-5022	HSSA 10	DRYWELL STEAM DECK, AZ 220, ELEV. 605	ISI-0280-C (1 OF 1)	N	N
150	2-47B458S0006	2-47B458S0006	2-SNUB-075-5023	HSSA 10	DRYWELL STEAM DECK, AZ 128, ELEV. 608	ISI-0280-C (1 OF 1)	N	N
151	2-47B458S0007	2-47B458S0007	2-SNUB-075-5024	HSSA 10	DRYWELL STEAM DECK, AZ 135, ELEV. 608	ISI-0280-C (1 OF 1)	N	N
154	RSSG-3	47B2401-26	2-SNUB-001-5022	PSA 10	DRYWELL, AZ 330, ELEV. 580	2-ISI-0412-C (4 OF 9)	Y	Y
155	RSSG-4	47B2401-26	2-SNUB-001-5023	PSA 10	DRYWELL, AZ 330, ELEV. 580	2-ISI-0412-C (4 OF 9)	Y	Y
156	RSSG-5	47B2401-27	2-SNUB-001-5024	PSA 10	DRYWELL, AZ 345, ELEV. 583	2-ISI-0412-C (4 OF 9)	Y	Y
157	RSSH-3	47B2401-31	2-SNUB-001-5027	PSA 10	DRYWELL, AZ 330, ELEV. 580	2-ISI-0412-C (4 OF 9)	Y	Y
158	RSSH-4	47B2401-31	2-SNUB-001-5028	PSA 10	DRYWELL, AZ 330, ELEV. 580	2-ISI-0412-C (4 OF 9)	Y	Y
159	RSSH-5	47B2401-32	2-SNUB-001-5029	PSA 10	DRYWELL, AZ 351, ELEV. 573	2-ISI-0412-C (4 OF 9)	Y	Y
160	RSSJ-3	47B2401-36	2-SNUB-001-5032	PSA 10	DRYWELL, AZ 235, ELEV. 583	2-ISI-0412-C (8 OF 9)	N	N
161	RSSJ-4	47B2401-36	2-SNUB-001-5033	PSA 10	DRYWELL, AZ 235, ELEV. 583	2-ISI-0412-C (8 OF 9)	N	N
162	RSSK-4	47B2401-41	2-SNUB-001-5037	PSA 10	DRYWELL, AZ 330, ELEV. 577	2-ISI-0412-C (4 OF 9)	Y	Y
163	MSS-8N	47B2401-49	2-SNUB-001-5075	PSA 10	DRYWELL STEAM DECK, AZ 98, ELEV.587	2-ISI-0412-C (2 OF 9)	N	N
164	MSS-8S	47B2401-49	2-SNUB-001-5074	PSA 10	DRYWELL STEAM DECK, AZ 101, ELEV.587	2-ISI-0412-C (2 OF 9)	N	N
165	MSS-9N	47B2401-51	2-SNUB-001-5062	PSA 10	DRYWELL, AZ 101, ELEV. 564	2-ISI-0412-C (2 OF 9)	N	N
166	MSS-9S	47B2401-51	2-SNUB-001-5063	PSA 10	DRYWELL, AZ 102, ELEV. 564	2-ISI-0412-C (2 OF 9)	N	N
167	MSS-10N	47B2401-54	2-SNUB-001-5073	PSA 10	DRYWELL STEAM DECK, AZ 262, ELEV. 587	2-ISI-0412-C (8 OF 9)	N	N
168	MSS-10S	47B2401-54	2-SNUB-001-5072	PSA 10	DRYWELL STEAM DECK, AZ 262, ELEV. 587	2-ISI-0412-C (8 OF 9)	N	N
169	MSS-11	47B2401-55	2-SNUB-001-5069	PSA 3	DRYWELL GRATING, AZ 260, ELEV. 576	2-ISI-0412-C (8 OF 9)	Y	Y
170	RSSK-5	47B2401-41-1	2-SNUB-001-5071	PSA 10	DRYWELL GRATING, AZ 330, ELEV. 577	2-ISI-0412-C (4 OF 9)	Y	Y
171	RSSL-3	47B2401-46-1	2-SNUB-001-5040	PSA 10	DRYWELL GRATING, AZ 224, ELEV. 583	2-ISI-0412-C (8 OF 9)	N	N
172	RSSL-4	47B2401-46-1	2-SNUB-001-5041	PSA 10	DRYWELL GRATING, AZ 223, ELEV. 583	2-ISI-0412-C (8 OF 9)	N	N
173	MSS-14	47B401-1-1	2-SNUB-001-5061	PSA 3	DRYWELL GRATING, AZ 263, ELEV. 561	2-ISI-0412-C (8 OF 9)	N	N
174	2-47B408S0069	2-47B408S0069	2-SNUB-068-5005	PSA 35	DRYWELL, RECIRC PMP MTR, AZ 295, ELEV. 566	2-ISI-0278-C (1 OF 2)	N	Y
175	2-47B408S0067	2-47B408S0067	2-SNUB-068-5006	LISEGA 307256	DRYWELL, RECIRC PMP MTR, AZ 335, ELEV 566	2-ISI-0278-C (1 OF 2)	N	Y
176	2-47B408S0052	2-47B408S0052	2-SNUB-068-5007	LISEGA 307256	DRYWELL, RECIRC PMP MTR, AZ 125, ELEV. 566	2-ISI-0278-C (2 OF 2)	N	Y

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EX	SUPPORT #	SNUBBER DWG #	UNID #	TYPE/SIZE	LOCATION	ISI DWG #	Scaffold Required For Visual	Scaffold Required For Functional Test
177	2-47B408S0054	2-47B408S0054	2-SNUB-068-5008	LISEGA 307256	DRYWELL, RECIRC PMP MTR, AZ 145, ELEV. 566	2-ISI-0278-C (2 OF 2)	N	Y
178	2-47B408S0068	2-47B408S0068	2-SNUB-068-5009	PSA 35	DRYWELL, RECIRC PMP MTR, AZ 315, ELEV. 570	2-ISI-0278-C (1 OF 2)	N	Y
179	2-47B408S0053	2-47B408S0053	2-SNUB-068-5010	LISEGA 307256	DRYWELL, RECIRC PMP MTR, AZ 135, ELEV. 570	2-ISI-0278-C (2 OF 2)	N	Y
180	2-47B408S0071	2-47B408S0071	2-SNUB-068-5011	ADH 70	DRYWELL, RECIRC HEADER, AZ 266, ELEV. 582	2-ISI-0278-C (1 OF 2)	Y	Y
181	2-47B408S0073	2-47B408S0073	2-SNUB-068-5012	ADH 70	DRYWELL, RECIRC HEADER, AZ 326, ELEV. 582	2-ISI-0278-C (1 OF 2)	Y	Y
182	2-47B408S0076	2-47B408S0076	2-SNUB-068-5013	ADH 130	DRYWELL, RECIRC HEADER, AZ 34, ELEV. 582	2-ISI-0278-C (2 OF 2)	Y	Y
183	2-47B408S0078	2-47B408S0078	2-SNUB-068-5014	ADH 50	DRYWELL, RECIRC HEADER, AZ 114, ELEV. 582	2-ISI-0278-C (2 OF 2)	Y	Y
184	2-47B452S0235	2-47B452S0235	2-SNUB-074-5037	ADH 20	DRYWELL GRATING, AZ 25, ELEV. 580	2-ISI-0276-C (1 OF 1)	Y	Y
185	2-47B452S0240	2-47B452S0240	2-SNUB-074-5038	ADH 30	DRYWELL GRATING, AZ 5, ELEV. 579	2-ISI-0276-C (1 OF 1)	Y	Y
186	2-47B452S0227	2-47B452S0227	2-SNUB-074-5039	ADH 30	DRYWELL GRATING, AZ 325, ELEV. 577	2-ISI-0276-C (1 OF 1)	Y	Y
187	2-47B415S0001	2-47B415S0001	2-SNUB-003-5015	ADH 10	DRYWELL STEAM DECK, AZ 22, ELEV. 599	2-ISI-0277-C (1 OF 1)	Y	Y
188	2-47B415S0002	2-47B415S0002	2-SNUB-003-5016	ADH 10	DRYWELL STEAM DECK, AZ 37, ELEV. 599	2-ISI-0277-C (1 OF 1)	Y	Y
189	2-47B415S0003	2-47B415S0003	2-SNUB-003-5017	HSSA 10	DRYWELL STEAM DECK, AZ 56, ELEV. 584	2-ISI-0277-C (1 OF 1)	N	N
190	2-47B415S0004	2-47B415S0004	2-SNUB-003-5018	HSSA 10	DRYWELL STEAM DECK, AZ 56, ELEV. 584	2-ISI-0277-C (1 OF 1)	N	N
191	2-47B415S0005	2-47B415S0005	2-SNUB-003-5019	HSSA 10	DRYWELL STEAM DECK, AZ 97, ELEV. 601	2-ISI-0277-C (1 OF 1)	Y	Y
192	2-47B415S0006	2-47B415S0006	2-SNUB-003-5020	PSA 10	DRYWELL STEAM DECK, AZ 83, ELEV. 601	2-ISI-0277-C (1 OF 1)	Y	Y
193	2-47B415S0007	2-47B415S0007	2-SNUB-003-5021	PSA 35	DRYWELL STEAM DECK, AZ 90, ELEV. 584	2-ISI-0277-C (1 OF 1)	N	N
194	2-47B415S0008	2-47B415S0008	2-SNUB-003-5022	PSA 100	DRYWELL STEAM DECK, AZ 135, ELEV. 585	2-ISI-0277-C (1 OF 1)	N	N
195	2-47B415S0009	2-47B415S0009	2-SNUB-003-5023	PSA 35	DRYWELL STEAM DECK, AZ 150, ELEV. 585	2-ISI-0277-C (1 OF 1)	N	N
196	2-47B415S0021	2-47B415S0021	2-SNUB-003-5024	HSSA 10	DRYWELL STEAM DECK, AZ 322, ELEV. 601	2-ISI-0277-C (1 OF 1)	Y	Y
197	2-47B415S0010	2-47B415S0010	2-SNUB-003-5025	HSSA 10	DRYWELL STEAM DECK, AZ 338, ELEV. 601	2-ISI-0277-C (1 OF 1)	Y	Y
198	2-47B415S0011	2-47B415S0011	2-SNUB-003-5026	HSSA 10	DRYWELL STEAM DECK, AZ 303, ELEV. 583	2-ISI-0277-C (1 OF 1)	N	N
199	2-47B415S0012	2-47B415S0012	2-SNUB-003-5027	HSSA 10	DRYWELL STEAM DECK, AZ 303, ELEV. 584	2-ISI-0277-C (1 OF 1)	N	N
200	2-47B415S0013	2-47B415S0013	2-SNUB-003-5028	HSSA 10	DRYWELL STEAM DECK, AZ 263, ELEV. 601	2-ISI-0277-C (1 OF 1)	Y	Y
201	2-47B415S0014	2-47B415S0014	2-SNUB-003-5029	HSSA 10	DRYWELL STEAM DECK, AZ 277, ELEV. 601	2-ISI-0277-C (1 OF 1)	Y	Y
202	2-47B415S0019	2-47B415S0019	2-SNUB-003-5030	PSA 10	DRYWELL STEAM DECK, AZ 270, ELEV. 584	2-ISI-0277-C (1 OF 1)	Y	Y
203	2-47B415S0017	2-47B415S0017	2-SNUB-003-5031	PSA 10	DRYWELL STEAM DECK, AZ 220, ELEV. 585	2-ISI-0277-C (1 OF 1)	N	Y

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EX	SUPPORT #	SNUBBER DWG #	UNID #	TYPE/SIZE	LOCATION	ISI DWG #	Scaffold Required For Visual	Scaffold Required For Functional Test
204	2-47B415S0018	2-47B415S0018	2-SNUB-003-5032	PSA 35	DRYWELL STEAM DECK, AZ 221, ELEV. 585	2-ISI-0277-C (1 OF 1)	N	Y
205	47B400S0201L	47B400S0201	2-SNUB-001-5043	PSA 10	DRYWELL STEAM DECK, AZ 82, ELEV. 585	2-ISI-0279-C (1 OF 4)	N	N
206	47B400S0201U	47B400S0201	2-SNUB-001-5042	PSA 10	DRYWELL STEAM DECK, AZ 82, ELEV. 587	2-ISI-0279-C (1 OF 4)	N	N
207	TELE-3	2-47B400S0115	2-SNUB-001-5044	PSA 10	DRYWELL STEAM DECK, AZ 280, ELEV. 588	2-ISI-0279-C (1 OF 4)	N	N
208	TELE-4	2-47B400S0116	2-SNUB-001-5045	PSA 10	DRYWELL STEAM DECK, AZ 280, ELEV. 585	2-ISI-0279-C (1 OF 4)	N	N
209	2-47B400S0096	2-47B400S0096	2-SNUB-001-5047	HSSA 20	DRYWELL STEAM DECK, AZ 105, ELEV. 585	2-ISI-0279-C (1 OF 4)	N	Y
210	2-47B400S0097	2-47B400S0097	2-SNUB-001-5048	HSSA 20	DRYWELL STEAM DECK, AZ 90, ELEV. 585	2-ISI-0279-C (1 OF 4)	Y	Y
211	2-47B400S0098	2-47B400S0098	2-SNUB-001-5049	PSA 35	DRYWELL STEAM DECK, AZ 115, ELEV. 585	2-ISI-0279-C (2 OF 4)	N	N
212	2-47B400S0099	2-47B400S0099	2-SNUB-001-5050	HSSA 30	DRYWELL STEAM DECK, AZ 90, ELEV. 585	2-ISI-0279-C (2 OF 4)	N	N
213	2-47B400S0101	2-47B400S0101	2-SNUB-001-5051	PSA 35	DRYWELL STEAM DECK, AZ 30, ELEV. 584	2-ISI-0279-C (2 OF 4)	N	Y
214	2-47B400S0102	2-47B400S0102	2-SNUB-001-5052	PSA 35	DRYWELL STEAM DECK, AZ 36, ELEV. 584	2-ISI-0279-C (2 OF 4)	N	Y
215	2-47B400S0103	2-47B400S0103	2-SNUB-001-5053	HSSA 20	DRYWELL STEAM DECK, AZ 31, ELEV. 584	2-ISI-0279-C (2 OF 4)	N	Y
216	2-47B400S0104	2-47B400S0104	2-SNUB-001-5054	ADH 30	DRYWELL STEAM DECK, AZ 240, ELEV. 585	2-ISI-0279-C (2 OF 4)	N	N
217	2-47B400S0105	2-47B400S0105	2-SNUB-001-5055	HSSA 30	DRYWELL STEAM DECK, AZ 260, ELEV. 585	2-ISI-0279-C (2 OF 4)	N	N
218	2-47B400S0106	2-47B400S0106	2-SNUB-001-5056	PSA 10	DRYWELL STEAM DECK, AZ 313, ELEV. 585	2-ISI-0279-C (2 OF 4)	N	Y
219	2-47B400S0107	2-47B400S0107	2-SNUB-001-5057	HSSA 10	DRYWELL STEAM DECK, AZ 325, ELEV. 583	2-ISI-0279-C (2 OF 4)	Y	Y
220	2-47B400S0108	2-47B400S0108	2-SNUB-001-5058	HSSA 20	DRYWELL STEAM DECK, AZ 322, ELEV. 585	2-ISI-0279-C (2 OF 4)	N	Y
221	2-47B400S0109	2-47B400S0109	2-SNUB-001-5059	HSSA 20	DRYWELL STEAM DECK, AZ 254, ELEV. 585	2-ISI-0279-C (1 OF 4)	N	Y
222	2-47B400S0110	2-47B400S0110	2-SNUB-001-5060	HSSA 20	DRYWELL STEAM DECK, AZ 257, ELEV. 585	2-ISI-0279-C (1 OF 4)	N	Y
223	RSSA-1	47B2401-2	2-SNUB-001-5001	PSA 10	DRYWELL STEAM DECK, AZ 61, ELEV. 585	2-ISI-0412-C (2 OF 9)	N	N
224	RSSA-2	47B2401-2	2-SNUB-001-5002	PSA 10	DRYWELL STEAM DECK EL. 585 AZ 65	2-ISI-0412-C (2 OF 9)	N	N
225	RSSA-3	47B2401-3	2-SNUB-001-5003	PSA 10	DRYWELL STEAM DECK EL. 585 AZ 70	2-ISI-0412-C (2 OF 9)	N	N
226	RSSA-4	47B2401-3	2-SNUB-001-5004	PSA 10	DRYWELL STEAM DECK EL. 585 AZ 70	2-ISI-0412-C (2 OF 9)	N	N
227	RSSB-1	47B2401-6	2-SNUB-001-5005	PSA 10	DRYWELL STEAM DECK EL. 585 AZ 140	2-ISI-0412-C (6 OF 9)	N	N
228	RSSB-2	47B2401-6	2-SNUB-001-5006	PSA 10	DRYWELL STEAM DECK EL. 585 AZ 140	2-ISI-0412-C (6 OF 9)	N	N
229	RSSC-1	47B2401-9	2-SNUB-001-5007	PSA 10	DRYWELL STEAM DECK EL. 585 AZ 35	2-ISI-0412-C (2 OF 9)	N	N
230	RSSC-2	47B2401-9	2-SNUB-001-5008	PSA 10	DRYWELL STEAM DECK EL. 585 AZ 30	2-ISI-0412-C (2 OF 9)	N	N
231	RSSC-3	47B2401-10	2-SNUB-001-5009	PSA 10	DRYWELL STEAM DECK EL. 585 AZ 40	2-ISI-0412-C (2 OF 9)	N	N

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EX	SUPPORT #	SNUBBER DWG #	UNID #	TYPE/SIZE	LOCATION	ISI DWG #	Scaffold Required For Visual	Scaffold Required For Functional Test
232	RSSC-4	47B2401-10	2-SNUB-001-5010	PSA 10	DRYWELL STEAM DECK EL. 585 AZ 45	2-ISI-0412-C (2 OF 9)	N	N
233	RSSD-1	47B2401-13	2-SNUB-001-5011	PSA 10	DRYWELL STEAM DECK EL. 585 AZ 45	2-ISI-0412-C (2 OF 9)	N	N
234	RSSD-2	47B2401-13	2-SNUB-001-5012	PSA 10	DRYWELL STEAM DECK EL. 585 AZ 55	2-ISI-0412-C (2 OF 9)	N	N
235	RSSD-3	47B2401-14	2-SNUB-001-5013	PSA 10	DRYWELL STEAM DECK EL. 585 AZ 55	2-ISI-0412-C (2 OF 9)	N	N
236	RSSD-4	47B2401-14	2-SNUB-001-5014	PSA 10	DRYWELL STEAM DECK EL. 585 AZ 55	2-ISI-0412-C (2 OF 9)	N	N
237	RSSE-2	47B2401-17	2-SNUB-001-5015	PSA 10	DRYWELL STEAM DECK EL. 585 AZ 150	2-ISI-0412-C (6 OF 9)	N	N
238	RSSE-3	47B2401-17	2-SNUB-001-5016	PSA 10	DRYWELL STEAM DECK EL. 585 AZ 150	2-ISI-0412-C (6 OF 9)	N	N
239	RSSE-4	47B2401-18	2-SNUB-001-5017	PSA 10	DRYWELL STEAM DECK EL. 585 AZ 135	2-ISI-0412-C (6 OF 9)	N	N
240	RSSF-1	47B2401-22	2-SNUB-001-5018	PSA 10	DRYWELL STEAM DECK EL. 585 AZ 145	2-ISI-0412-C (6 OF 9)	N	N
241	RSSF-2	47B2401-22	2-SNUB-001-5019	PSA 10	DRYWELL STEAM DECK EL. 585 AZ 145	2-ISI-0412-C (6 OF 9)	N	N
242	RSSG-1	47B2401-25	2-SNUB-001-5020	PSA 10	DRYWELL STEAM DECK EL. 585 AZ 330	2-ISI-0412-C (4 OF 9)	N	N
243	RSSG-2	47B2401-25	2-SNUB-001-5021	PSA 10	DRYWELL STEAM DECK EL. 585 AZ 335	2-ISI-0412-C (4 OF 9)	N	N
244	RSSH-1	47B2401-30	2-SNUB-001-5025	PSA 10	DRYWELL STEAM DECK EL. 585 AZ 335	2-ISI-0412-C (4 OF 9)	N	N
245	RSSH-2	47B2401-30	2-SNUB-001-5026	PSA 10	DRYWELL STEAM DECK EL. 585 AZ 335	2-ISI-0412-C (4 OF 9)	N	N
246	RSSJ-1	47B2401-35	2-SNUB-001-5030	PSA 10	DRYWELL STEAM DECK EL. 585 AZ 230	2-ISI-0412-C (8 OF 9)	N	N
247	RSSJ-2	47B2401-35	2-SNUB-001-5031	PSA 10	DRYWELL STEAM DECK EL. 585 AZ 230	2-ISI-0412-C (8 OF 9)	N	N
248	RSSK-1	47B2401-39	2-SNUB-001-5034	PSA 10	DRYWELL STEAM DECK EL. 585 AZ 315	2-ISI-0412-C (4 OF 9)	N	N
249	RSSK-2	47B2401-40	2-SNUB-001-5035	PSA 10	DRYWELL STEAM DECK EL. 585 AZ 322	2-ISI-0412-C (4 OF 9)	N	N
250	RSSK-3	47B2401-40	2-SNUB-001-5036	PSA 10	DRYWELL STEAM DECK EL. 585 AZ 322	2-ISI-0412-C (4 OF 9)	N	N
251	RSSL-1	47B2401-45	2-SNUB-001-5038	PSA 10	DRYWELL STEAM DECK EL. 585 AZ 225	2-ISI-0412-C (8 OF 9)	N	N
252	RSSL-2	47B2401-45	2-SNUB-001-5039	PSA 10	DRYWELL STEAM DECK EL. 585 AZ 225	2-ISI-0412-C (8 OF 9)	N	N
268	2-47B456S0048	2-47B456S0048	2-SNUB-071-5016	PSA 1	DRYWELL EL. 579 AZ 218	2-ISI-0274-C (3 OF 3)	Y	Y
269	2-47B400S0212 N	2-47B400S0212	2-SNUB-001-5079	PSA 10	DRYWELL STEAM DECK EL. 606 AZ 72	2-ISI-0279-C (1 OF 4)	N	N
270	2-47B400S0212 S	2-47B400S0212	2-SNUB-001-5078	PSA 10	DRYWELL STEAM DECK EL. 606 AZ 72	2-ISI-0279-C (1 OF 4)	N	N
271	2-47B464S0228	2-47B464S0228	2-SNUB-070-5009	PSA 3	TOP OF TORUS, BAY 11 EL. 553, AZ 32	ISI-0032-C (1 OF 1)	N	N
272	2-47B465H0027	2-47B465H0027	2-SNUB-010-5001	PSA 3	RX BLDG VSL VENTS & DRAINS EL. 634 AZ 225	2-ISI-0279-C (4 OF 4)	N	N
273	2-47B400S0211	2-47B400S0211	2-SNUB-001-5076	PSA 35	DRYWELL STEAM DECK EL. 585 AZ 135	2-ISI-0279-C (2 OF 4)	N	N
274	2-47B400S0205	2-47B400S0205	2-SNUB-001-5077	PSA 35	DRYWELL STEAM DECK EL. 585 AZ 215	2-ISI-0279-C (2 OF 4)	N	N

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EX	SUPPORT #	SNUBBER DWG #	UNID #	TYPE/SIZE	LOCATION	ISI DWG #	Scaffold Required For Visual	Scaffold Required For Functional Test
275	2-47B400S0210	2-47B400S0210	2-SNUB-001-5070	PSA 1/2	DRYWELL, EL. 577 AZ 260		Y	Y
276	2-47B400S0207	2-47B400S0207	2-SNUB-001-5068	PSA 1/4	DRYWELL, EL. 566 AZ 255	2-ISI-0279-C (3 OF 4)	N	N
277	2-47B400S0208	2-47B400S0208	2-SNUB-001-5067	PSA 1/2	DRYWELL EL. 566 AZ 255	2-ISI-0274-C (3 OF 3)	N	N
278	2-47B400S0028	2-47B400S0028	2-SNUB-001-5065	PSA 1/4	DRYWELL EL.565, AZ 180	2-ISI-0279-C (3 OF 4)	N	N
279	2-47B553S0008 U	2-47B553S0008	2-SNUB-002-5016	PSA 3	TORUS, OFF SIDE OF CATWALK, BAY 6		Y	Y
280	2-47B553S0008 L	2-47B553S0008	2-SNUB-002-5017	PSA 3	TORUS, OFF SIDE OF CATWALK, BAY 6		Y	Y
281	2-47B400S0157	2-47B400S0157	2-SNUB-001-5064	PSA 1/4	DRYWELL, EL 575, AZ 150	2-ISI-0274-C (3 OF 3)	Y	Y
282	2-47B462S0127	2-47B462S0127	2-SNUB-063-5003	PSA 1	DRYWELL STEAM DECK EL. 585 AZ 180		L	Y
283	2-47B452S0237	2-47B452S0237	2-SNUB-074-5057	HSSA 20	DRYWELL BASEMENT EL. 556 AZ 90	2-ISI-0278-C (2 OF 2)	N	N
284	2-47B455S0042 S	2-47B455S0042	2-SNUB-073-5009	PSA 3	SE QUAD HPCI RM, R13 EL. 533	2-ISI-0130-C (1 OF 3)	Y	Y
285	2-47B455S00042 N	2-47B455S0042	2-SNUB-073-5010	PSA 3	SE QUAD HPCI RM, R13 EL. 533	2-ISI-0130-C (1 OF 3)	Y	Y
294	2-47B400S0030	2-47B400S0030	2-SNUB-001-5066	PSA 1/4	DRYWELL, EL.565, AZ 150	2-ISI-0279-C (3 OF 4)	N	N
295	2-47B468S0028	2-47B468S0028	2-SNUB-085-5001	PSA 1/2	R-12 &13, R&S LINE EL.582		Y	Y
296	2-47B408S0082 S	2-47B408S0082	2-SNUB-068-5022	ADH 30	DRYWELL GRATING EL. 568 AZ 90	2-ISI-0278-C (2 OF 2)	N	N
297	2-47B408S0082 N	2-47B408S0082	2-SNUB-068-5023	ADH 30	DRYWELL GRATING EL. 568 AZ 90	2-ISI-0278-C (2 OF 2)	N	N
298	2-47B408S0081	2-47B408S0081	2-SNUB-068-5021	ADH 30	DRYWELL BASEMENT EL. 556 AZ 270	2-ISI-0278-C (1 OF 2)	N	N
299	2-47B455-2123	2-47B455-2123	2-SNUB-073-5005	LISEGA 305253	DRYWELL, AZ 45, EL. 571 ABOVE FCV-073-02	2-ISI-0275-C (1 OF 1)	Y	Y
300	2-47B455-2124 U	2-47B455-2124	2-SNUB-073-5006	LISEGA 305253	DRYWELL, AZ 45, EL. 562 BELOW FCV-073-02	2-ISI-0275-C (1 OF 1)	Y	Y
301	2-47B455-2124 L	2-47B455-2124	2-SNUB-073-5007	LISEGA 305253	DRYWELL, AZ 45, EL. 560 BELOW FCV-073-02	2-ISI-0275-C (1 OF 1)	Y	Y

Attachment 1
(Page 1 of 1)

Surveillance Instruction Review Form

DATE/TIME STARTED: _________ DATE/TIME COMPLETED: ________

REASON FOR TEST:

☐ Scheduled Surveillance UNIT MODE _______

☐ System Inoperable (Explain in Remarks)

☐ Maintenance (WO No. _______________)

☐ Other (Explain in Remarks)

PRE-TEST REMARKS: ____

PERFORMED BY:

Initials	Name (Print)	Name (Signature)

NOTE: The following entries for contacting Shift Manager/Unit Supervisor shall be marked **N/A** if the snubber is **NOT** Inoperable.

NOTIFY Shift Manager/Unit Supervisor when snubber found Inoperable. __________ (Initial)

SM/Unit Supervisor Contacted ________ Date______ Time______

NOTIFY Shift Manager/Unit Supervisor when snubber Operability is restored. __________ (Initial)

SM/Unit Supervisor Contacted ________ Date______ Time______

MECHANICAL MAINTENANCE REVIEWER (MM) ____________ Date__________

Signature attests that I understand the scope and purpose of this instruction and that, to the best of my knowledge, it was properly performed in accordance with instruction in that: the recording, reduction, and evaluation of data were complete and correct; acceptance criteria were met or justification for exceptions provided; portions of test performed were appropriate for specified test conditions or reasons for test; deficiencies were evaluated and dispositioned; reportability was evaluated; marginal results were evaluated with respect to potential for future problems based on operating experience and regulatory requirements; and instruction was fully completed, as applicable, except as noted in Post-Test Remarks.

SNUBBER ENGINEER/
SITE CIVIL ENGINEERING REVIEWER - ____________________ Date__________

SCHEDULING COORDINATOR ____________________ Date__________

POST-TEST REMARKS: ____

Attachment 2
(Page 1 of 4)

Snubber Visual Examination Checklist for all Snubbers

Unit 2 Snubber UNID No. 2-SNUB- ____ - ____ Serial No. ______ Exam No. ______

Manuf. ANCHOR/DARLING,BERGEN-PATERSON,LISEGA,PSA,FRONEK ______ Size ______
(Circle type snubber being examined)

PER No. ____________________

Attachments 3, 4, 5, or Attachment 9 shall be attached with Attachment 2 for the appropriate type hydraulic snubber being examined.

A. The snubber has no visible indications of damage or impaired operability. The following attributes will determine the acceptability in accordance with the appropriate acceptance criteria. Responses marked (UNAC) are unacceptable and require immediate notification of the Snubber Engineer/SE Designee at the time of discovery. Handling of deficiencies shall be completed in accordance with SPP-8.1 and SPP-3.1.

AC	UNAC	N/A	
☐	☐	☐	**OBSERVE** for any signs of over stressing
☐	☐	☐	**OBSERVE** the exposed parts of the snubber for broken parts, deformation or other damage, such as, weld arc strikes, paint, weld slag, adhesive, or other deposits on piston rod or support cylinder that could result in unacceptable snubber performance.
☐	☐	☐	**OBSERVE** to see if there is any evidence that a snubber has experienced a potentially damaging transient since the last examination.
☐	☐	☐	**OBSERVE** the snubber and piston rod for excessive corrosion, solid deposits, which could impair operability of the snubber.
☐	☐	☐	**OBSERVE** to ensure the security of essential threaded fasteners of the snubber installation such as tie rods and rear bracket bolts.
☐	☐	☐	Evidence of clamp binding due to missing spacers.
☐	☐	☐	**OBSERVE** hydraulic snubbers for evidence of damage to external tubing. (external pipe configuration snubbers)
☐	☐	☐	**OBSERVE** for evidence of torsional binding (i.e. mechanical snubber twisted along its axis by the pipe clamp and structural attachments).

______________________ ____________
Performer Signature Date

Attachment 2
(Page 2 of 4)

Snubber Visual Examination Checklist for all Snubbers

Unit 2 Snubber UNID No. 2-SNUB- ______ - ______ Serial No. ________ Exam No. ______

Manuf. ANCHOR/DARLING,BERGEN-PATERSON,LISEGA,PSA,FRONEK ________ Size ______

(Circle type snubber being examined)

PER No. ____________________

B. Attachments to the foundation or supporting structure are functional. The following attributes will determine acceptability in accordance with the appropriate acceptance criteria. Responses marked (UNAC) are unacceptable and require immediate notification of the Snubber Engineer/SE Designee at the time of discovery. Handling of deficiencies shall be completed in accordance with SPP-8.1 and SPP-3.1.

AC	UNAC	N/A	
☐	☐	☐	**OBSERVE** the exposed hanger structural steel, pipe clamps, base plates, lugs and other such plates of attachment for broken parts, deformation or other damage.
☐	☐	☐	**OBSERVE** welds for visible damage at base plates, lugs, and other such plates of attachment.

____________________ ________
Performer Signature Date

C. Fasteners for the attachment of the snubber to the component and to the snubber anchorage are functional. The following attributes will determine the acceptability in accordance with the appropriate acceptance criteria. Responses marked (UNAC) are unacceptable and require immediate notification of the Snubber Engineer/SE Designee at the time of discovery. Handling of deficiencies shall be completed in accordance with SPP-8.1 and SPP-3.1.

AC	UNAC	N/A	
☐	☐	☐	**OBSERVE** to ensure the security of essential threaded fasteners such as anchorage bolts and pipe clamp bolts that are exposed.
☐	☐	☐	**OBSERVE** to ensure clevis bolts or pins are properly installed.

____________________ ________
Performer Signature Date

Attachment 2
(Page 3 of 4)

Snubber Visual Examination Checklist for all Snubbers

Unit 2 Snubber UNID No. 2-SNUB- ____-____ Serial No. ________ Exam No. ______

Manuf. ANCHOR/DARLING,BERGEN-PATERSON,LISEGA,PSA,FRONEK ________ Size ______

(Circle type snubber being examined)

PER No. ____________________

OBSERVE for the following attributes which may cause future problems but do **NOT** affect snubber operability or any acceptance criteria.

If any of the following problems are found, **NOTE** them in the Remarks, and **NOTIFY** the Snubber Engineer/SE Designee to disposition the finding on Attachment 7.

Pits, scratches, or rough places observed on the piston rod that would **NOT** contact the piston seal.

Cotter pins properly installed with legs bent sufficiently to prevent cotter pin from backing out.

Pivot pin retaining ring is properly installed, if required.

Security locking devices (i.e., locking tabs or wire) on snubber attachment bolts properly installed, if required.

Centerline of the clamp assembly and structural attachment offset (i.e., a misalignment with the snubber axis exists) by no greater than + or - 6 degrees based on the clearances between the rod eyes, or paddles, and the attachment clevis. Contact of these parts, which produces a side load on the snubber is unacceptable.

OBSERVE spacers are installed on each side of the snubber eye to reduce the misalignment and /or binding. Space shall **NOT** exceed 1/16 inch on either side or 1/8 inch total.

Piston Indication for PSA mechanical snubber________inches.

Stroke Position for Lisega Type 30 hydraulic snubber________inches.

______________________________ Performer Signature ____________ Date

Attachment 2
(Page 4 of 4)

Snubber Visual Examination Checklist for all Snubbers

Unit 2 Snubber UNID No. 2-SNUB- _____ - _____ Serial No. _______ Exam No. _____

Manuf. ANCHOR/DARLING,BERGEN-PATERSON,LISEGA,PSA,FRONEK Size ______

(Circle type snubber being examined)

PER No. ____________________

Snubber meets all visual acceptance criteria. **N/A** this step if functional test is required.

______________________________ __________
Snubber Engineer/SE Designee Date

Snubber is found acceptable functionally and meets all applicable acceptance criteria. **N/A** this step if snubber meets all visual acceptance criteria.

______________________________ __________
Snubber Engineer/SE Designee Date

Based on the As-Found condition, including functional test if applicable, is the snubber operable? Yes____ No____

If "NO", notify Shift Manager/Unit Supervisor immediately of the inoperable snubber.

______________________________ __________
Snubber Engineer/SE Designee Date

Prior to the final review the Snubber Engineer/SE Designee shall **VERIFY** that all of the appropriate Attachments 3, 4, 5, 6, 7, 8, or 9 have been completed and are attached with Attachment 2.

Final Review

______________________________ __________
Snubber Engineer/SE Designee Date

REMARKS: ____
____
____
____

Attachment 3
(Page 1 of 2)

Snubber Visual Examination Checklist for Bergen-Paterson, Anchor/Darling, Fronek Hydraulic Snubbers

Unit 2 Snubber UNID No. 2-SNUB- ______ - ______ Serial No. ________ Exam No. ______

Manuf. BERGEN-PATERSON, ANCHOR/DARLING, FRONEK Size ______

(Circle type snubber being examined)

PER No. ____________________

FLUID LEVEL ACCEPTABILITY FOR BERGEN-PATERSON, ANCHOR/DARLING AND FRONEK HYDRAULIC SNUBBERS.

AC	UNAC	N/A	
☐	☐	☐	If the Reservoir Plunger cannot be seen the reservoir is empty. The fluid level is unacceptable and the snubber is visually inoperable.
			NOTIFY immediately the Snubber Engineer/SE Designee. **WRITE** a Work Order to REMOVE the snubber and take to the snubber test facility to have functional test performed.
			Piston rod extension is the distance from end of front head to the punch mark or scribed line (nearest 1/8 inch)- 3/4 inch, as shown on Page 2 of 2 of this Attachment:
			________ -3/4 = ________ inches
			RECORD the reading from the scale along the protective tube, as shown on Page 2 of 2 of this Attachment:
			________ inches
			Reservoir plunger reading from above: ________
			Minus piston rod extension from above: - ________
			Calculated value: ________
☐	☐	☐	If the calculated value above is greater than +2 inches, the fluid level is unacceptable.
☐	☐	☐	If the fluid level is unacceptable, but **NOT** empty, **ADD** GE SF 1154 Silicon fluid using a fluid gun with a special hydraulic fill coupling until the fluid level reading is at or approximately the same as the piston rod extension given above.
			RECORD fluid PIC ticket and TIIC numbers below for any fluid added.
			Fluid PIC ticket (SIR) ____________ , TIIC ____________
			EXAMINE snubber for location and cause of any leaks. **RECORD** locations in Remarks. **NOTIFY** the Snubber Engineer/SE Designee, to evaluate and document the unacceptable condition on Attachment 7. **TAKE** appropriate action.

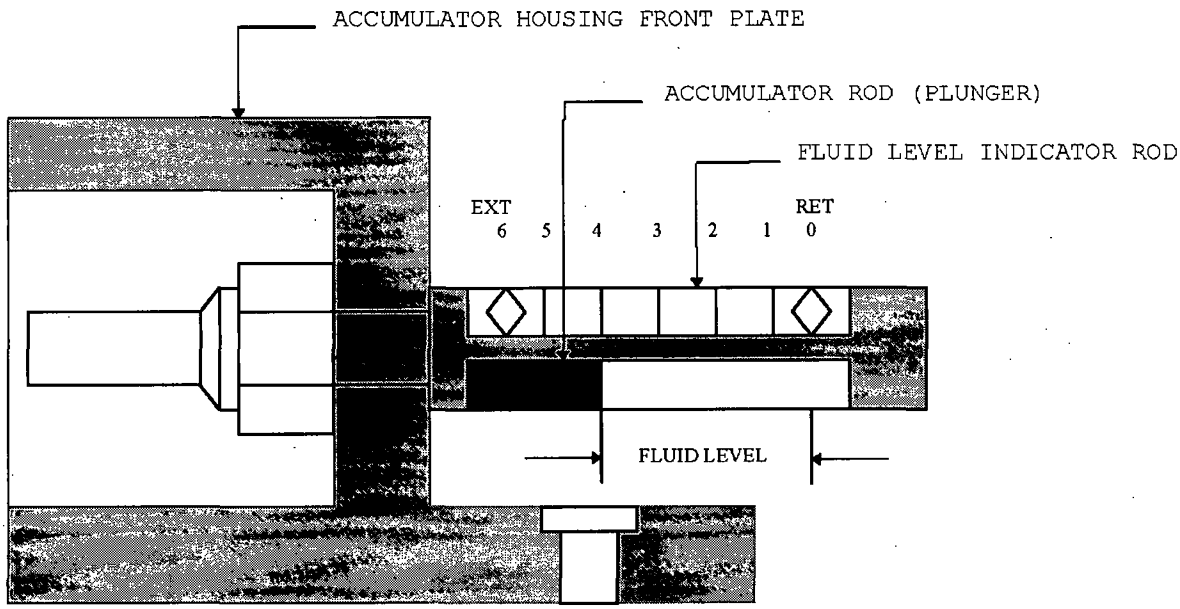
______________________ ____________

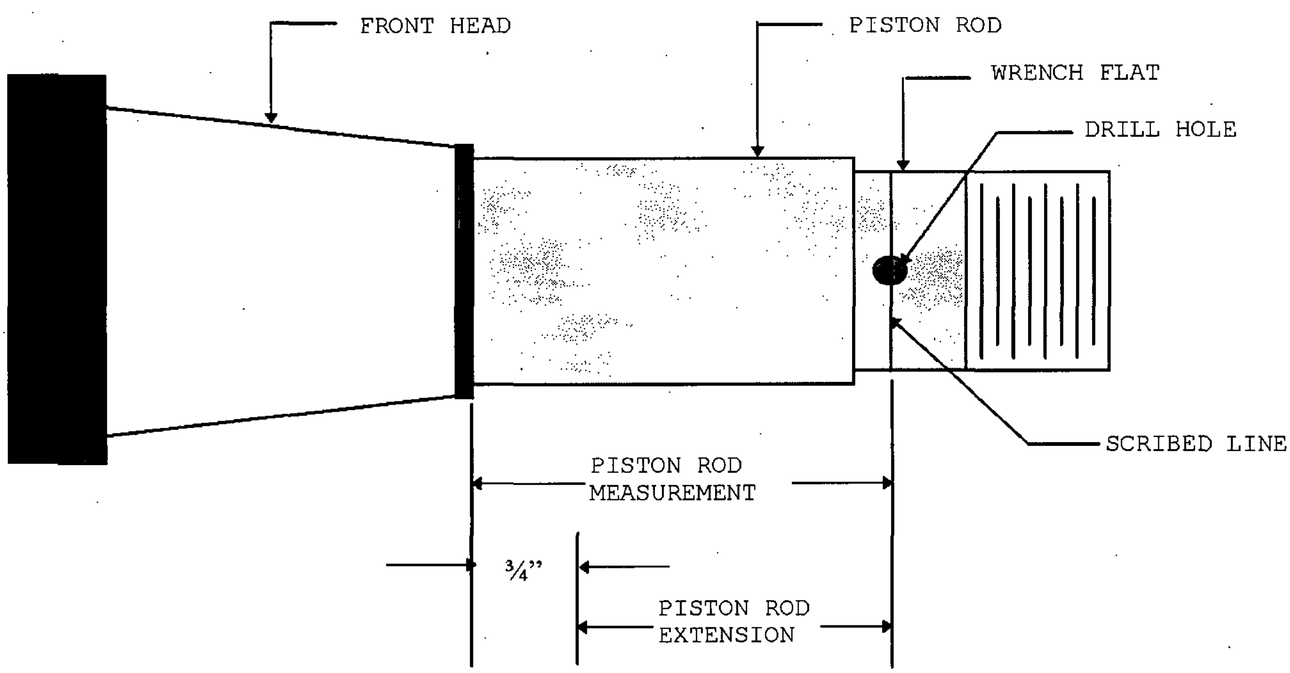
Performer Signature Date

Attachment 3
(Page 2 of 2)

Snubber Visual Examination Checklist for Bergen-Paterson, Anchor/Darling, Fronek Hydraulic Snubbers

BERGEN-PATERSON, ANCHOR/DARLING, FRONEK FLUID LEVEL INDICATOR AND PISTON ROD MEASUREMENT METHODS





Attachment 4
(Page 1 of 4)

Snubber Visual Examination Checklist for Lisega Torus Dynamic Restraint Hydraulic Snubbers

Unit 2 Snubber UNID No. 2-SNUB- ______ - ______ Serial No. ______ Exam No. ______

Manuf. LISEGA TORUS DYNAMIC RESTRAINT SNUBBERS Size ______

PER No. ____________________

FLUID LEVEL ACCEPTABILITY FOR LISEGA TORUS DYNAMIC RESTRAINT SUNBBERS.

AC	UNAC	N/A	
☐	☐	☐	If the Reservoir Plunger cannot be seen the reservoir is empty. The fluid level is unacceptable and the snubber is visually inoperable. **NOTIFY** immediately the Snubber Engineer/SE Designee. **WRITE** a Work Order to REMOVE the snubber and take to the snubber test facility to have functional test performed.

Piston rod extension is the distance X, from the front head of the snubber to the outside edge marked on piston rod (nearest 1/8 inch), as shown on Page 2 of 4 of this Attachment. **RECORD** on Page 4 of 4 of this Attachment.

Reservoir plunger reading is the reading from the rear plate to the end of the plunger rod (nearest 1/8 inch), as shown on Page 2 of 4 of this Attachment: L=______inches, and **RECORD** on Page 4 of 4 of this Attachment.

COMPARE the piston rod position X from above to the reservoir plunger reading to ensure measurements are within the minimum and maximum limits shown on the chart on Page 3 of 4 of this Attachment.

If the fluid level is below L minimum, **ADD** Lisega AP-280 Silicon fluid using a fluid gun with a special hydraulic fill coupling to the maximum fluid level reading, as shown on the chart on Page 3 of 4 of this Attachment. If the fluid level is above the L maximum value, **CONTACT** the Snubber Engineer/SE Designee.

RECORD fluid PIC ticket and TIIC numbers, and optimum/maximum fluid level added above and **COMPLETE** page 4 of 4 of this Attachment.

Fluid PIC ticket (SIR) ________________ , TIIC ________________

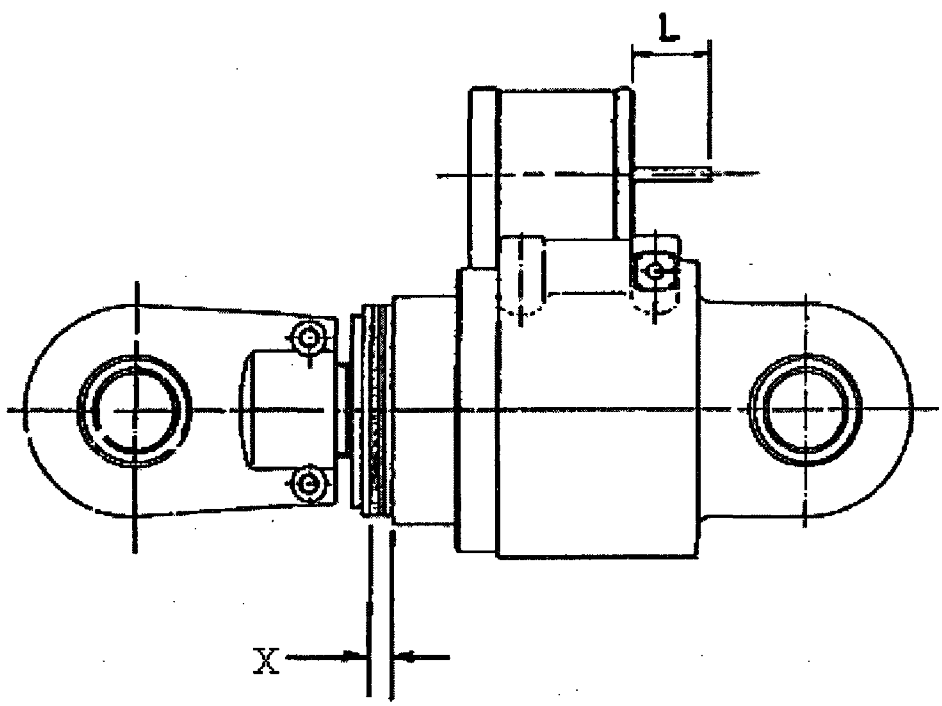
EXAMINE snubber for location and cause of any leaks. **RECORD** locations in Remarks on Attachment 1. **NOTIFY** the Snubber Engineer/SE Designee, to evaluate and document the unacceptable condition on Attachment 7 and take appropriate action.

____________________ Performer Signature ________ Date

Attachment 4
(Page 2 of 4)

Snubber Visual Examination Checklist for Lisega Torus Dynamic Restraint Hydraulic Snubbers

LISEGA MINIMUM AND MAXIMUM FLUID LEVEL PLUNGER
AND PISTON POSITION MEASUREMENT IN THE FIELD



Attachment 4
(Page 3 of 4)

Snubber Visual Examination Checklist for Lisega Torus Dynamic Restraint Hydraulic Snubbers

LISEGA MINIMUM AND MAXIMUM FLUID LEVEL PLUNGER AND PISTON POSITION MEASUREMENT IN THE FIELD

If the as-found plunger position "L" is below the minimum value given, **ADD** Lisega AP-280 fluid to the snubber to bring the reservoir, as close as possible, to its optimum (maximum) level. No functional testing of the Lisega Torus Dynamic Restraint Snubber is required due to this refilling operation. The Lisega Torus Dynamic Restraint Snubbers are **NOT** considered inoperable until the reservoir is completely empty. This can be identified when the reservoir plunger is flush with the top of the reservoir plate. The snubber will be considered inoperable when the "L" dimension is equal to "0".

Nomenclature:

X - Measurement of the snubber piston rod position in inches from the front head of the snubber to the outside edge marked piston rod.

L Minimum - The minimum fluid level in the reservoir using the reservoir piston rod position measured from the front of the reservoir to the end of the reservoir piston rod.

L Maximum - The maximum fluid level in the reservoir using the reservoir piston rod position measured from the front of the reservoir to the end of the reservoir piston rod.

If the X measurement is between the values given in the table below for "X", then GO TO the next lower reading for "X" to determine the L Minimum and L maximum.

X (INCHES)	L MINIMUM (INCHES)	L MAXIMUM (INCHES)
0.000	2.52	3.31
0.125	2.43	3.22
0.250	2.34	3.13
0.375	2.26	3.04
0.500	2.17	2.96
0.625	2.08	2.87
0.750	1.99	2.78
0.875	1.91	2.69
1.000	1.82	2.60
1.125	1.73	2.52
1.250	1.64	2.42
1.375	1.55	2.34
1.500	1.47	2.25

Attachment 4
(Page 4 of 4)

Snubber Visual Examination Checklist for Lisega Torus Dynamic Restraint Hydraulic Snubbers

SURVEILLANCE INSTRUCTION DATA SHEET
LISEGA LARGE BORE TORUS DYNAMIC RESTRAINT
SNUBBER VISUAL EXAMINATION CHECKLIST

Work Order: ____________ Outage/Cycle (RFO): ____________

Fluid Type: ____________ Visual Exam Date: ____________

Fluid PIC Ticket (SIR): ____________ , TIIC: ____________

Ex No.	TDR UNID	TDR No.	Serial Number	Piston Rod Pos. "X"(in)	Reservoir Plunger Reading "L"(in)	*Optimum/ Max. As-Left Fluid Level (in)	Performer Signature/ Date

* Optimum/Maximum Fluid Level is reservoir plunger reading measured after adding the Lisega AP-280 silicon fluid to the snubber.

Attachment 5
(Page 1 of 2)

Snubber Visual Examination Checklist for Lisega Type 30 Hydraulic Snubbers

Unit 2 Snubber UNID No. 2-SNUB- ______ - ______ Serial No. ______ Exam No. ______

Manuf. LISEGA ______ Size ______

PER No. ______

FLUID LEVEL ACCEPTABILITY FOR LISEGA TYPE 30 HYDRAULIC SUNBBERS.

AC	UNAC	N/A	
☐	☐	☐	If the silver color of the stainless steel Cylinder Tube can be seen through the sight-glass of the snubber, the reservoir is full. The fluid level is acceptable and the snubber is operable.

If there is a loss of fluid, the brass alloy Reservoir Piston gold color can be seen through the sight-glass partially or completely. Evidence of fluid loss implies snubber degradation, and the snubber is visually inoperable. **NOTIFY** immediately the Snubber Engineer/SE Designee. **WRITE** a Work Order to REMOVE the snubber and take to the snubber test facility to have functional test performed.

RECORD fluid PIC ticket and TIIC numbers below for any fluid added.

Fluid PIC ticket (SIR) ______________, TIIC ______________

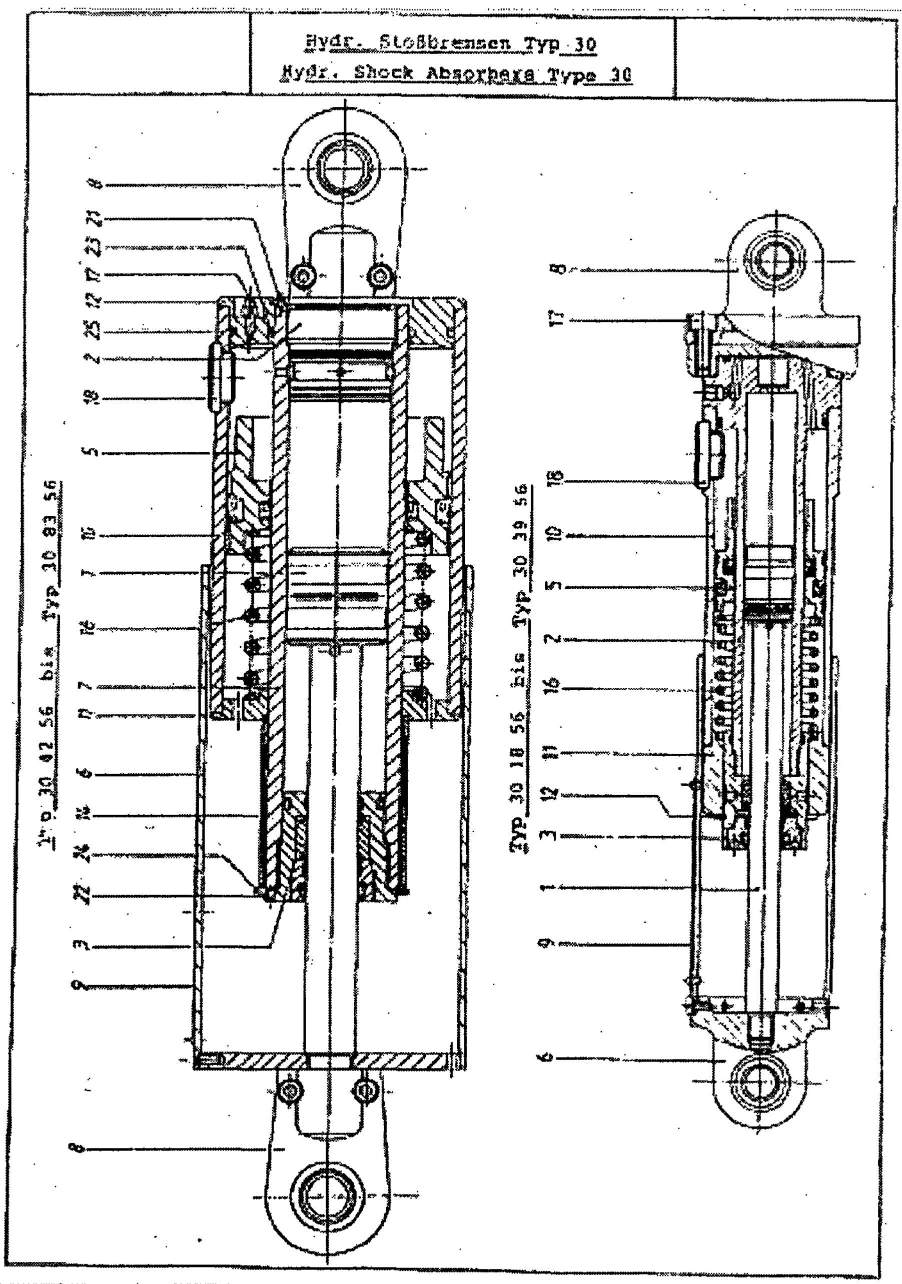
EXAMINE snubber for location and cause of any leaks. **RECORD** locations in Remarks on Attachment 1.

______________________ ______________

Performer Signature Date

Attachment 5
(Page 2 of 2)

Snubber Visual Examination Checklist for Lisega Type 30 Hydraulic Snubbers



Legend: Referring to Figure on the left (Typ 304256 through Type 308356)

Item 5 - Reservoir piston, brass alloy, gold color.

Item 7 - Cylinder Tube, stainless steel, silver color.

Item 18 - Sight - glass is on brass alloy housing near the back end of the snubber body.

Attachment 6
(Page 1 of 1)

Evaluation of Loose or Missing Attachment Fasteners

This evaluation should be performed only when fasteners, used for attachment of snubber(s) to a system/component and to snubber anchorage, are discovered loose or missing. This Attachment may be completed on the computer, as a form, if desired.

Unit 2 Snubber UNID No. 2-SNUB- _____ - _____ Serial No. _______ Exam No. ______

Manuf. ANCHOR/DARLING,BERGEN-PATERSON,LISEGA,PSA,FRONEK Size ______

(Circle type snubber being examined)

PER No. ____________________

1. Describe the discovered condition(s):

2. If possible, determine cause:

3. Evaluate to determine whether the cause may be localized or generic. Use this evaluation to select and list other suspect snubbers for verifying attachment fasteners, as applicable.

4. Describe the corrective action(s) and provide the "As-Found" test results.

Evaluated by: ______________________________ ______________

Snubber Engineer/SE Designee Date

Attachment 7
(Page 1 of 2)

Engineering Evaluation of Unacceptable Indication

This Attachment may be completed on the computer, as a form, if desired.

Unit 2 Snubber UNID No. 2-SNUB- ______-______ Serial No. ________ Exam No. ______

Manuf. ANCHOR/DARLING,BERGEN-PATERSON,LISEGA,PSA,FRONEK ________ Size ______

(Circle type snubber being examined)

PER No. ____________________

1. Describe the unacceptable indication(s) observed.

2. What is the cause of the indication(s) (i.e., vibration, water leaking on surface, possible failure to torque at last reinstallation, etc.)?

3. What is the basis for the conclusions reached by question 2 above?

4. Which additional snubbers are suspected to be subject to the same unacceptable indication(s)?

Attachment 7
(Page 2 of 2)

Engineering Evaluation of Unacceptable Indication

This Attachment may be completed on the computer, as a form, if desired.

Unit 2 Snubber UNID No. 2-SNUB- ______ - ______ Serial No. ________ Exam No. ______

Manuf. ANCHOR/DARLING,BERGEN-PATERSON,LISEGA,PSA,FRONEK ________ Size ______

(Circle type snubber being examined)

PER No. ____________________

5. What further examination(s) and/or test(s) of the initial and other suspect snubber(s) are to be performed?

6. What are the results of the examination(s) and/or test(s) performed by Step 5 above, and what changes in the initial evaluation should be made?

7. What corrective action(s) is/are to be taken for the initial snubber and/or any other suspect snubbers?

8. Has/have the corrective action(s) been taken? ____ YES ____ NO

9. Number of snubbers, initial and other suspect snubbers, that will affect the next visual inspection interval. ________

Evaluated by: ______________________________ ______________

Snubber Engineer/SE Designee Date

Attachment 8
(Page 1 of 2)

Engineering Evaluation of Transient Event Indication(s) and Effect(s)

This Attachment may be completed on the computer, as a form, if desired.

Unit 2 Snubber UNID No. 2-SNUB- ______ - ______ Serial No. ________ Exam No. ______

Manuf. ANCHOR/DARLING,BERGEN-PATERSON,LISEGA,PSA,FRONEK Size ______

(Circle type snubber being examined)

PER No. ____________________

1. What is/are the indication(s) that a potentially damaging transient event has taken place?

2. Which snubber installation(s) are suspected of being subject to the transient?

3. What are the result(s) of the visual examination for bent or broken parts and other signs of damage to the installation(s)? (Attach extra sheets, if necessary, to detail the results for each suspect installation(s).)

Attachment 8
(Page 2 of 2)

This Attachment may be completed on the computer, as a form, if desired.

Unit 2 Snubber UNID No. 2-SNUB- ______ - ______ Serial No. ________ Exam No. ______

Manuf. ANCHOR/DARLING,BERGEN-PATERSON,LISEGA,PSA,FRONEK Size ______

(Circle type snubber being examined)

PER No. ____________________

4. What additional test(s), NDE examination(s), etc., is/are required to be performed to verify structural integrity of the snubber(s) and its attachment(s)? (PSA snubbers are to be stroked to verify they are **NOT** jammed or broken internally.)

5. What are the results of the additional test(s) and/or examination(s) performed in Section 4?

6. What is/are the corrective action(s) to be taken to correct the problem(s) found?

7. Has/have the corrective action(s) been completed for all suspect snubbers?

8. How many of the snubber installations are to be counted as inoperable to affect the surveillance schedule?

Evaluated by: ______________________________ ____________

Snubber Engineer/SE Designee Date

Attachment 9
(Page 1 of 6)

Bergen-Paterson Torus Dynamic Restraint Fluid Level Check Instructions

NOTES

1) A Bergen-Paterson Torus Dynamic Restraint (TDR) found with fluid level below the minimum level shown in Table 1, shall be refilled to its optimum level as shown in Table 2. However, the TDR is **NOT** inoperable until the reservoir fluid level is equal to or less than 0.375 inches.

   Also, a leaking Bergen-Paterson Torus Dynamic Restraint, for which reservoir filling to maintain acceptable fluid level is required at time intervals of 3 hours or less, shall be declared inoperable.

2) The minimum fluid level shown in Table 1 for the BERGEN-PATERSON Torus Dynamic Restraints is dependent on the fluid temperature.

3) If the RESTRAINT temperature does **NOT** match one of the temperatures in either Table 1 or 2, GO TO the next higher temperature for the minimum or optimum level.

1.0 INSTRUCTIONS:

[1] **OBTAIN** permission from the Shift Manager/Unit Supervisor to perform this verification.

[2] **NOTIFY** the Unit Operator and Snubber Engineer/SE Designee that the SI is beginning.

[3] **ENTER** the required information on the Surveillance Instruction Review Form, Attachment 1.

[4] **MEASURE** the surface temperature at the reservoir of the BERGEN-PATERSON Torus Restraint at the time of surveillance performance. **RECORD** the surface temperature, the calibrated thermometer unique identifier (UNID) number, the calibration due date, and the calibration accuracy (Calibration accuracy ± 2°F) on Attachment 9.

[5] **RECORD** the calibrated micrometer (calibration accuracy ± 0.01 inches) unique identifier (UNID) number and the calibration due date on Attachment 9.

[6] **MEASURE** the as-found distance the plunger extends above the reservoir end cap, to the nearest 0.05 inch as shown on Page 4 of 6 of this Attachment using a calibrated M&TE Measuring Test Equipment to determine the as-found fluid level. The value indicated on Page 4 of 6 of this Attachment should be read as 1.250".

Attachment 9
(Page 2 of 6)

Bergen-Paterson Torus Dynamic Restraint Fluid Level Check Instructions

1.0 INSTRUCTIONS: (continued)

[7] **RECORD** the as-found plunger extension/reading, and location(s)/source(s) of any leak(s) in the appropriate space on Attachment 9.

[8] If the as-found plunger reading is equal to or less than 0.375 inches, **NOTIFY** the Snubber Engineer/SE Designee immediately that the snubber is inoperable. **ENTER** on Attachment 1 the name of Shift Manager/Unit Supervisor notified.

[9] When the snubber/restraint is inoperable an Engineering Evaluation of Unacceptable Indication, Attachment 7, is required to be completed by the Snubber Engineer/SE Designee or Site Engineering Civil personnel.

[10] **ENTER** in Attachment 1, the name of Shift Manager/Unit Supervisor notified when snubber operability is restored.

[11] If the as-found plunger reading is below the value given in Table 1 for the appropriate temperature, the fluid reservoir shall be refilled to the optimum level. If the as-found plunger reading is equal to or above the value given in Table 1 for the appropriate temperature, the fluid reservoir may be refilled to the optimum level. No functional testing of the BERGEN-PATERSON Torus Dynamic Restraint is required due to the fluid refilling operation.

[12] **CLEAN** the snubber by wiping down with clean rags or a nylon brush wetted with solvent, then **WIPE** the snubber dry with a clean rag.

[13] **ENTER** the as-left fluid level reading for each snubber on Attachment 9.

[14] **EXAMINE** each hydraulic snubber for other source(s) of fluid leak(s), and **LIST** in the appropriate space on Attachment 9.

[15] **VERIFY** all data meets the acceptable limits.

[16] **VERIFY** the Data Package Attachment 9, Cover Sheet Attachment 1, and other applicable Attachment(s) have been completed properly.

Attachment 9
(Page 3 of 6)

Bergen-Paterson Torus Dynamic Restraint Fluid Level Check Instructions

1.0 INSTRUCTIONS: (continued)

TABLE 1

TEMPERATURE (Degrees F)	MINIMUM LEVEL (Inches)	TEMPERATURE (Degrees F)	MINIMUM LEVEL (Inches)	TEMPERATURE (Degrees F)	MINIMUM LEVEL (Inches)
50	.90	67	1.17	84	1.44
51	.92	68	1.19	85	1.45
52	.94	69	1.20	86	1.47
53	.95	70	1.22	87	1.48
54	.97	71	1.23	88	1.50
55	.99	72	1.25	89	1.51
56	1.00	73	1.26	90	1.53
57	1.01	74	1.28	91	1.54
58	1.03	75	1.29	92	1.56
59	1.05	76	1.31	93	1.58
60	1.06	77	1.33	94	1.59
61	1.08	78	1.34	95	1.61
62	1.09	79	1.36	96	1.62
63	1.11	80	1.37	97	1.64
64	1.12	81	1.39	98	1.65
65	1.14	82	1.40	99	1.67
66	1.15	83	1.42	100	1.69

ADD fluid to the snubber to bring the reservoir as close as possible, to its optimum level, as determined from Table 2, using the appropriate temperature recorded earlier.

TABLE 2

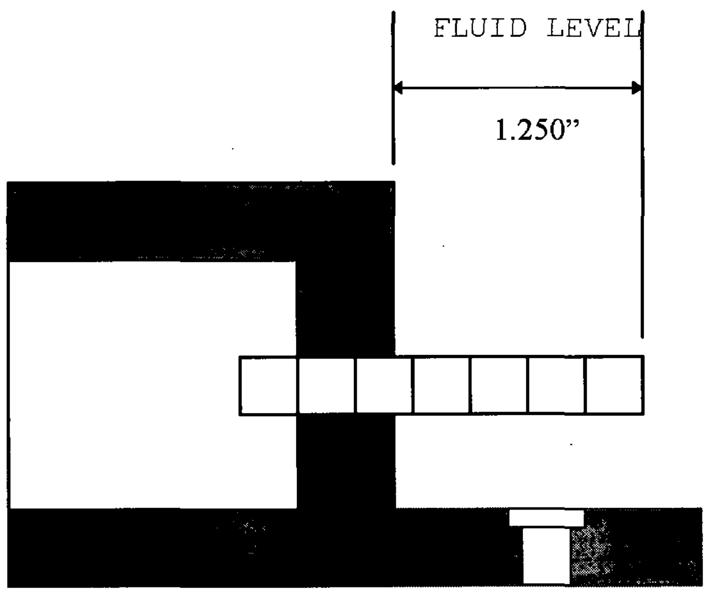
TEMPERATURE (Degrees F)	OPTIMUM LEVEL (Inches)	TEMPERATURE (Degrees F)	OPTIMUM LEVEL (Inches)	TEMPERATURE (Degrees F)	OPTIMUM LEVEL (Inches)
50	3.33	67	3.07	84	2.80
51	3.31	68	3.05	85	2.78
52	3.30	69	3.03	86	2.77
53	3.28	70	3.02	87	2.75
54	3.27	71	3.00	88	2.74
55	3.25	72	2.99	89	2.72
56	3.24	73	2.97	90	2.71
57	3.22	74	2.96	91	2.69
58	3.21	75	2.94	92	2.67
59	3.19	76	2.92	93	2.66
60	3.17	77	2.91	94	2.64
61	3.16	78	2.89	95	2.63
62	3.14	79	2.88	96	2.61
63	3.13	80	2.86	97	2.60
64	3.11	81	2.85	98	2.58
65	3.10	82	2.83	99	2.57
66	3.08	83	2.82	100	2.55

Attachment 9
(Page 4 of 6)

Bergen-Paterson Torus Dynamic Restraint Fluid Level Check Instructions

1.0 INSTRUCTIONS: (continued)

BERGEN-PATERSON TORUS DYNAMIC RESTRAINT RESERVOIR
LEVEL INDICATOR READING

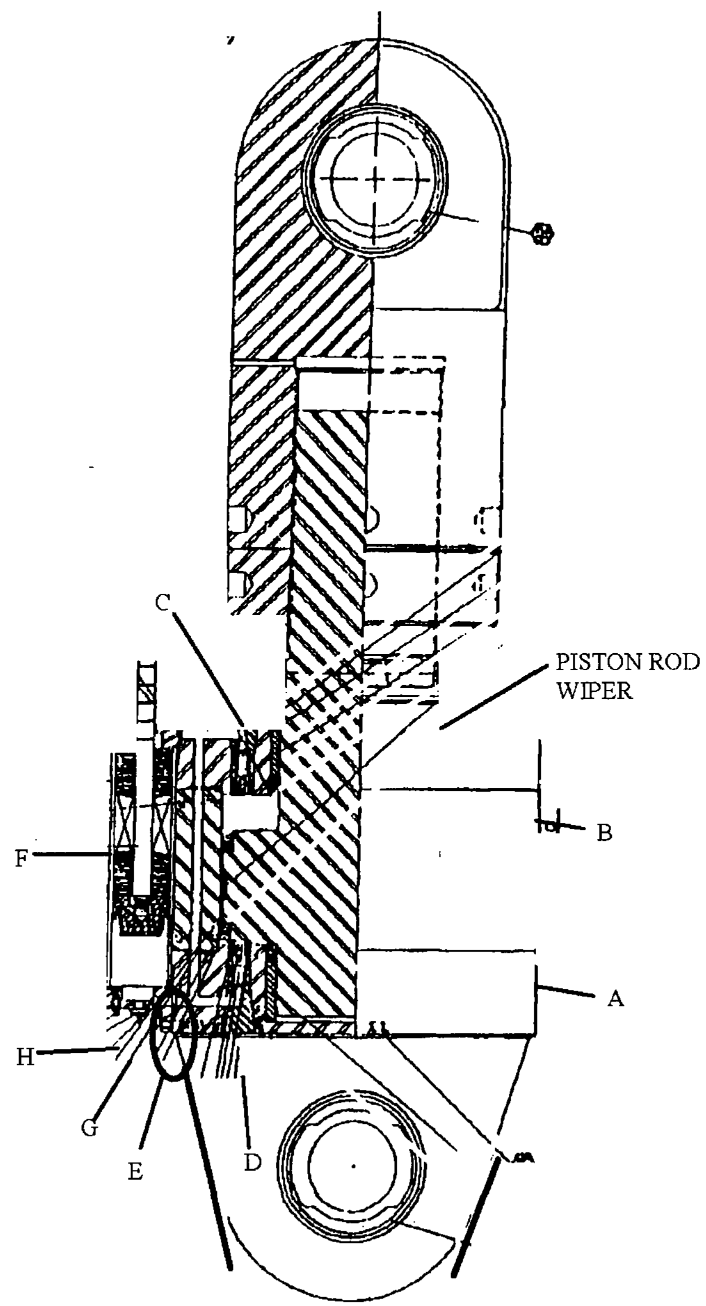


Attachment 9
(Page 5 of 6)

Bergen-Paterson Torus Dynamic Restraint Fluid Level Check Instructions

1.0 INSTRUCTIONS: (continued)

BERGEN-PATERSON TORUS DYNAMIC RESTRAINT
LEAKAGE LOCATION POINTS



Attachment 9
(Page 6 of 6)

Bergen-Paterson Torus Dynamic Restraint Fluid Level Check Instructions

1.0 INSTRUCTIONS: (continued)

SURVEILLANCE INSTRUCTION DATA SHEET
BERGEN-PATERSON TORUS DYNAMIC RESTRAINT
SNUBBER VISUAL EXAMINATION CHECKLIST

Thermometer UNID ____________ M&TE Test Equip. UNID ____________

(Cal Accuracy ± 2°F) (Cal Accuracy ± 0.01 in)

Calibration Due Date ____________ Calibration Due Date ____________

Fluid PIC Ticket (SIR) ____________ TIIC: ____________

EXAM NO.	TORUS DYNAMIC RESTRAINT	UNID	AS-FOUND FLUID LEVEL (inches)	LEAK LOCATION	AS-LEFT FLUID LEVEL (inches)	RESTRAINT SURFACE TEMP.	*Performer Signature/Date

LEAKING LOCATION KEY

A) Base head seal
B) Rod head seal
C) Base valve seal
D) Rod valve seal
E) Reservoir to snubber body seal
F) Reservoir body
G) Reservoir fill plug
H) Reservoir bleed plug

I) Others (list below)

*SIGNATURE ATTESTS THAT:

1) Location and cause of any leaks has been identified.
2) Fluid level has been properly determined per Table 1.
3) Fluid added per Table 2, if required.
4) Calibration accuracy ± 2°F
5) Calibration M&TE equipment ± 0.01 inches.

Tennessee Valley Authority
Browns Ferry Nuclear Plant, Unit 2

Relief Request No. 2-ISI-40, Snubbers Inspection and Testing

Relief Request No. 2-ISI-40, Reference D

Browns Ferry Nuclear Plant, Mechanical Preventive Instruction, MPI-0-000-SNB004, "Removal and Reinstallation of Snubbers"

TVA

Browns Ferry Nuclear Plant

Unit 0

Mechanical Preventive Instruction

MPI-0-000-SNB004

Removal and Reinstallation of Snubbers

Revision 0037

Quality Related

Level of Use: Reference Use

Effective Date: 05-25-2009

Responsible Organization: MMG, Mechanical Maintenance

Prepared By: Randall Webb

Approved By: David Curry

Current Revision Description

Pages Affected: 5

Type of Change: INTENT Tracking Number: 038

Removed Precaution stating only one snubber may be removed from operable system at any given time. TRM 3.7.4 does not limit the number of snubbers that may be removed at any given time, but does place a time limitation (LCO) of 72 hours for system to be restored to operability.

Table of Contents

1.0 PURPOSE/SCOPE/FREQUENCY

1.1 Purpose

This instruction is to serve as a guide in the removal and reinstallation of Pacific Scientific Mechanical, Bergen-Paterson, Anchor/Darling, Fronek, Grinnell and Lisega Hydraulic and Bergen-Paterson or Lisega Torus Dynamic Restraint Snubbers. This procedure also serves as the pre-service inspection procedure for Section XI Repair/Replacement snubber work order packages.

1.2 Scope

This instruction is applicable to Pacific Scientific Mechanical, Bergen-Paterson, Anchor/Darling, Fronek, Grinnell and Lisega Hydraulic and Bergen-Paterson or Lisega Torus Dynamic Restraint Snubbers.

1.3 Frequency

[PER/C] Frequencies are established and maintained in accordance with the plant Preventive Maintenance (PM) Program and Qualification Maintenance Data Sheets (QMDS), as applicable, Surveillance Instructions or as required for maintenance. [PER BFPER940037]

2.0 REFERENCES

BFN-VTD-B209-0160, Vendor Technical Manual For Bergen-Paterson Reactor Torus Ring Hydraulic Shock Suppressers.

BFN-VTD-B209-0180, Installation Techniques For Bergen-Paterson Series 78000 Hydraulic Shock Suppressers.

BFN-VTD-B209-0200, Removal Techniques For Bergen-Paterson Series 78000 Hydraulic Shock Suppressers.

BFN-VTM-P029-0010, Vendor Technical Manual For Pacific Scientific Instruction Manual for Repair, Overhaul, Installation Maintenance of Mechanical Shock Arrestors.

BFN-VTD-P029-0050, Pacific Scientific Instruction Manual For Installation and Maintenance of Mechanical Shock Arrestors Models PSA-1/4, PSA-1/2, PSA-1, PSA-3, PSA-10, PSA-35, PSA-100

BFN-VMM-P029-0250, Vendor Miscellaneous Manual For Pacific Scientific Mechanical Shock Arrestors.

BFN-VTM-G257-0010, Vendor Technical Manual For Grinnell Corp. Hydraulic Snubbers

2.0 REFERENCES (continued)

BFN-VTM-L329-0010, Vendor Technical Manual For Lisega Reactor Torus Ring Hydraulic Snubbers

BFN-VTD-L329-0070, Installation and Maintenance Instructions For Lisega Hydraulic Snubbers

0-TI-397, Performance of Inspection/Verification by Maintenance

EDC 66240, Revise General Notes (Drawing 0-47B435-5B)

3.0 PRECAUTIONS/LIMITATIONS/ALARA

A. When removing or reinstalling a snubber, do **NOT** rotate the piston rod end of the unit. If the snubber cannot be removed or installed without rotating the piston, contact the Snubber Engineer/designee for instruction.

B. Caution should be taken **NOT** to drop any spacers, washers, cotter pins, etc., while removing end attachments.

C. Safety measures must be used to ensure personnel safety when working on difficult to reach snubbers.

D. At no time shall snubbers be used as steps or hand holds.

E. Use care when removing or installing attachment pins to avoid damage to end attachments and spherical bearings.

F. Steps deemed inapplicable to the specific type of snubber to be worked may be marked Not Applicable (N/A) with prior concurrence from the Work Supervisor. Concurrence must be documented in Section 8.0.

4.0 PREREQUISITES

A. Craftsmen conducting maintenance have reviewed and are familiar with this instruction.

B. Applicable portions of related WO are complete and Unit Supervisor's authorization obtained to begin work per SDP-MMDP-1, Maintenance Management System.

5.0 RECOMMENDED EQUIPMENT

NOTE

Part numbers furnished in this procedure are for reference only.

1/2" drive socket set

1/2" drive Torque wrench (5 to 250 ft-lbs.)

Adjustable wrenches (8" or 12")

Screwdriver (1/4" or 1/8" blade)

Vise grips

Needle-nose pliers

Slip-joint pliers

Snap ring pliers

Lock wire pliers

Lock wire (stainless steel)

Hammer (Rubber hammer, Mallet or soft-faced hammer)

Brass drift pin

Rigging slings and hoist

Ladders

Scaffolding

Safety belt

Flashlight

Inspection mirror

File (fine tooth)

Cotter pins

5.0 RECOMMENDED EQUIPMENT (continued)

Tie wire

Positioning fixture (BP P/N 78044).

Hand spanner wrench (BP P/N 78031).

Lifting fixture (BP P/N 78048).

Jam nut torquing fixture (BP P/N 78022).

Porta-power.

6.0 ACCEPTANCE REQUIREMENTS

Successful completion of the Work Order.

Date ________

7.0 INSTRUCTION STEPS

7.1 Preparation for Maintenance

NOTE

The following step is to be performed by all personnel performing this procedure.

[1] **READ** this procedure. **IF** required, **THEN**

CONTACT Work Supervisor for clarification. **WHEN** procedure is understood, **THEN**

PRINT your name and **SIGN** initials.

Printed Name	Initials

Date ________

7.1 Preparation for Maintenance (continued)

[2] **FOLLOW** the appropriate Removal and Reinstallation Attachment for the type snubber to be worked.

[2.1.1] **REFERENCE** Attachment 1 for Removal and Reinstallation of Hydraulic Snubbers.

[2.1.2] **REFERENCE** Attachment 2 for Removal and Reinstallation of Mechanical Pacific Scientific Snubbers.

[2.1.3] **REFERENCE** Attachment 3 for Removal and Reinstallation of Bergen-Paterson or Lisega Torus Dynamic Restraints.

[2.1.4] **REFERENCE** Section 7.3 for replacing old solid pins with the new two piece pin.

7.2 Staking of Carbon Steel Spherical Bearings

NOTE

The following is a list of Bergen-Paterson part numbers for strut and snubber assemblies which use carbon steel and stainless steel spherical bearings:

Stainless steel bearings: 2015, 2249 (end attachment end), 2250, 2251 (end attachment end), 2252, 2410 (end attachment end), 2411 (end attachment end), 2420, 2421, 2440, 2525, 2530, and 2540 (end attachment end).

Carbon steel bearings: 2000, 2010, 2100, 2200, 2249 (clamp end), 2251 (clamp end), 2410 (clamp end), 2411 (clamp end), 2510, 2515, and 2540 (clamp end).

[1] **IF** a snubber contains a stainless steel bearing which has become dislodged, **NOTIFY** the Snubber Engineer/designee for instruction. Stainless steel bearings are **NOT** to be staked.

[2] **IF** a snubber contains a carbon steel spherical bearing which has become dislodged, **STAKE** the spherical bearing in accordance with paragraph 7.2[3.2], unless it has been previously staked.

[2.1] **IF** the bearing has been staked previously, **REQUEST** the Site Engineering Lead Civil Engineer to provide needed corrective action.

Date ________

7.2 Staking of Carbon Steel Spherical Bearings (continued)

[3] **IF** a spherical bearing is found to be dislodged from the paddle housing, **REINSERT** by carefully pressing or tapping on the outer race.

[3.1] **USE** a Bergen-Paterson bearing installation tool or an appropriate sized pipe to assure proper alignment.

NOTE
The punch indentations should displace a small amount of metal over the edge of the spherical bearing race to keep it from dislodging again.

[3.2] After the spherical bearing has been reinserted into the paddle if required, **USE** a center punch and **MOVE** approximately 1/32 inch away from the exterior of the spherical bearing race and with as little force as possible **MAKE** four punch indentations equally spaced around the race at approximately 90 degrees, on both sides of the paddle.

[3.3] **VERIFY** the staking process has **NOT** damaged the race in any way, such as cracking, deforming, chips or flaking.

[3.4] **VERIFY** the ball moves with little force in the race.

[3.5] **IF** the ball sticks, **ROTATE** it to expose the exterior surface and **PLACE** a small amount of Never-Seize compound on it.

[3.6] **MOVE** the ball around until it moves with little force.

[3.7] **IF** the ball does **NOT** move with little force after this, **CONTACT** the Snubber Engineer/designee to evaluate the spherical bearing.

Date ________

7.3 Replacing Original One Piece Pins with New Two Piece Pins

NOTES

1) Pin replacement may begin on either end of the snubber.
2) After the first pin is replaced the steps are repeated to replace the pin on the opposite end.

[1] **REMOVE** original pin, retainers, and spacer washers.

[1.1] **RETAIN** spacer washers for reinstallation.

[1.2] **DISCARD** old pin and retainers.

[2] **VERIFY** the bore of the bracket and bearing are free of burrs, rust, and debris.

[3] **DISASSEMBLE** new pin by removing the slotted hex nut, washer, and sleeve.

[4] **APPLY** a thin film of lubricant to the OD of the sleeve, the threads and tapered surface of the pin. **USE** Never Seez Pure Nickel, Neolube 1 or 2, Felpro C5-A Nuclear Grade, Fel-Pro N-7000 or G.E. Silicone Grease, G-351.

[5] **ALIGN** hole in spherical bearing with bracket lug holes.

[6] **INSTALL** sleeve and spacer washers.

[6.1] **ENSURE** sleeve is in full contact with holes in the bracket lugs.

[7] **INSTALL** pin and **ATTACH** washer and slotted hex nut.

[8] **ADJUST** pin sleeve assembly by tightening the slotted hex nut snug until spherical bearing will **NOT** slide along sleeve.

[9] **ENSURE** spherical bearing is centered, approximately, between the bracket lugs.

[10] **INSTALL** cotter pin by slightly turning the slotted hex nut in either direction, as required, to allow the cotter pin to be inserted in the first available hole.

[11] **SPREAD** legs on cotter pin enough to prevent falling out.

Date ________

8.0 RETURN TO SERVICE

[1] **COMPLETE** Maintenance documentation in accordance with MMDP-1, Maintenance Management System. ________

[2] **ENSURE** printed names, initials and signatures of all personnel performing this instruction have been recorded below: ________

Printed Name	Initials	Signature

Comments: ______________________________________

____

____

____

____

Attachment 1
(Page 1 of 18)

Removal and Reinstallation of Hydraulic Snubbers

NOTES

1) The pivot pins and pipe clamp stud bolts are designed to be a light press fit in the snubber spherical bearing and in the attachment lug or pipe clamp.
2) Document removal and reinstallation data on Attachment 4 Data Sheet.

1.0 REMOVAL OF SNUBBERS

[1] **PERFORM** visual inspection of the snubber for any visible damage or fluid leakage.

[2] **ENSURE** snubber attachment fasteners are **NOT** loose or *missing prior to unpinning the snubber(s).*

[3] **IF** visible damage such as loose/missing attachment fasteners, or unacceptable conditions such as low fluid level or leakage are discovered, **NOTIFY** the Snubber Engineer/designee.

NOTES

1) Reference Illustration 1 during performance of the following step.
2) The following step is applicable to Bergen-Paterson, Anchor/Darling, and Fronek snubbers.

[4] **MEASURE** the "As-Found" index/plunger position setting to the nearest 1/8 inch. **RECORD** the value on Attachment 4 Data Sheet.

[4.1] **IF** the reservoir index/plunger cannot be seen, the fluid level is unacceptable and the snubber is visually inoperable.

[4.2] **IF** the snubber is visually inoperable, **NOTIFY** the Shift Manager/Unit Supervisor immediately and the Snubber Engineer/Designee. **INITIATE** a Work Order to remove the snubber for a functional test to determine operability.

Attachment 1
(Page 2 of 18)

Removal and Reinstallation of Hydraulic Snubbers

Date ________

1.0 REMOVAL OF SNUBBERS (continued)

NOTE
The piston rod extension is the distance from end of front head to the punch mark or scribed line on the piston.

[5] **RECORD** piston rod extension on Attachment 4 Data Sheet to the nearest 1/8 inch.

[6] **SUBTRACT** 3/4 inch from piston rod extension on Attachment 4 Data Sheet.

[7] **RECORD** actual piston reading on Attachment 4 Data Sheet.

[8] **SUBTRACT** actual piston reading from the "As-Found" index/plunger measurement. **RECORD** actual fluid level on Attachment 4 Data Sheet.

[8.1] **IF** the calculated value above is greater than +2 inches, the fluid level is unacceptable.

[8.2] **IF** the fluid level is unacceptable, but **NOT** empty, **ADD** GE SF 1154 Silicon fluid using a hydraulic fluid gun until the fluid level reading is at or approximately the same as the piston rod extension given above. **NOTIFY** the Snubber Engineer/Designee to take appropriate action.

Attachment 1
(Page 3 of 18)

Removal and Reinstallation of Hydraulic Snubbers

Date ________

1.0 REMOVAL OF SNUBBERS (continued)

NOTES
1) The following step is applicable to Grinnell snubbers.
2) Reference Illustration 3 during performance of the following step.

[9] **MEASURE** the "As-Found" position setting as follows (see Illustration 3). **RECORD** the value on Attachment 4 Data Sheet to the nearest 1/8 inch.

[9.1] **IF** the fluid in the plastic reservoir is below the supply hole for the snubber piston, the fluid level is unacceptable and the snubber is visually inoperable.

[9.2] **IF** the snubber is visually inoperable, **NOTIFY** the Shift Manager/Unit Supervisor immediately and the Snubber Engineer/Designee. **INITIATE** a Work Order to remove the snubber for a functional test to determine operability.

[9.3] **IF** the fluid level is above the supply hole for the snubber piston but below 1/2 full in the reservoir, **ADD** GE SF 1154 Silicon fluid through the reservoir vent hole until the reservoir is at least 1/2 full.

[9.4] **EXAMINE** the snubber for location of leaks. **NOTIFY** the Snubber Engineer/Designee to take appropriate action.

NOTE
In the following step, the tie wire should be tightened as much as possible.

[10] **PLACE** tie wire around the end of the snubber piston rod and an appropriate place on the body of the snubber to restrain the piston rod at the "As-Found" position setting for reinstallation.

[11] **ENSURE** 1/4 inch vent plug in reservoir cylinder is removed and a 1/4 inch solid plug is installed before snubber removal.

Attachment 1
(Page 4 of 18)

Removal and Reinstallation of Hydraulic Snubbers

Date ________

1.0 REMOVAL OF SNUBBERS (continued)

[12] **REMOVE** cotter pin(s) from the end of the clevis pins.

NOTE
Care should be exercised to catch the spacers as the pin or stud is removed.

[13] **USE** a chain fall, block and tackle, or similar method to secure and lower the unit for removal as necessary.

[14] **REMOVE** the pivot pins from the end attachment and/or pipe attachment, as required.

[15] **ENSURE** the snubber setting is **NOT** disturbed while unpinning the snubber, if possible.

[16] **TRANSPORT** the unit to the designated testing area after it has been decontaminated, if required.

1.2 Removal of Lisega Type 30 Snubbers

[1] **PERFORM** visual inspection of the snubber for any visible damage or fluid leakage.

[2] **ENSURE** snubber attachment fasteners are **NOT** loose or missing prior to unpinning the snubber(s).

Attachment 1
(Page 5 of 18)

Removal and Reinstallation of Hydraulic Snubbers

Date ________

1.2 Removal of Lisega Type 30 Snubbers (continued)

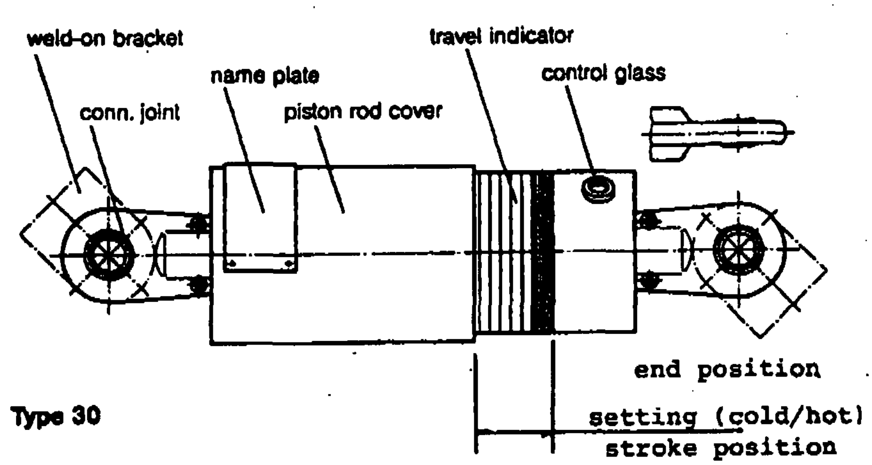
NOTES

1) The sightglass is located in a brass alloy housing near the back end of the snubber body.
2) The leading edge of the reservoir piston acts as the fluid level indicator.
3) When the reservoir is full, the sightglass will show the silver color of the stainless steel cylinder tube.
4) When there is a loss of fluid, the brass alloy (gold color) reservoir piston will appear in the sightglass, either partially or completely.

[3] **IF** visible damage such as loose/missing attachment fasteners, or unacceptable conditions such as low fluid level or leakage are discovered, **NOTIFY** the Snubber Engineer/designee.

[4] **MEASURE** the "As-Found" position setting as follows:

[4.1] **MEASURE** from the end position (last machined ring) on the snubber body to the face of the piston rod cover.



[4.2] **RECORD** the value on Attachment 4 Data Sheet.

Attachment 1
(Page 6 of 18)

Removal and Reinstallation of Hydraulic Snubbers

Date ________

2.0 REINSTALLATION OF HYDRAULIC SNUBBERS

CAUTION

Care should be exercised during the reinstallation of the snubber to prevent damage to the piston rod and the accumulator indicator housing.

2.1 Hydraulic Strut Assembly Installation

NOTES

1) The required thread engagement is verified by use of sight holes provided in the coupling. Threads must be visible at these holes to ensure the proper engagement of 1-1/2 times the diameter of the shaft is obtained.
2) Any required relocation of the strut attachment to clear an interference should be brought to the attention of Site Engineering (Civil).
3) When installing the threaded adapter, rotate either the adapter or the entire snubber unit to prevent possible scoring of the piston rod cylinder tube. Use the wrench flats provided on the piston rod to hold the rod in place and prevent scoring.

[1] Prior to the installation of the unit, **CHECK** that piston rod is at the "As-Found" position setting or approximately 1 inch less than the "As-Found" position setting as recorded on Attachment 4 Data Sheet.

[2] **ENGAGE** the piston rod in the threaded adapter until it is tight and aligned properly.

[3] **CHECK** for the required overall pin-to-pin dimension.

[4] **USE** a chain fall, block and tackle, or similar method to secure and raise the unit for installation as necessary.

[5] **ORIENT** snubber end attachment and **BOLT** in place.

Attachment 1
(Page 7 of 18)

Removal and Reinstallation of Hydraulic Snubbers

Date ________

2.1 Hydraulic Strut Assembly Installation (continued)

[6] **INSERT** clevis pins in the appropriate clevis.

[6.1] **IF** piston rod extends too far, **PERFORM** the following:

[6.1.1] **PUSH** or **PULL** on the piston rod, as required, to obtain the proper position setting,

OR

[6.1.2] To relieve the spring force and subsequent fluid pressure in the accumulator housing (1), **THREAD** the 5/16-18 NC rod with nut and two flat washers into the indicator rod (5) (Min. 1/2-inch) and **TIGHTEN** until resistance is felt on the indicator plunger (5) indicating compression of the accumulator spring (13a).

[6.1.3] **ADJUST** piston rod to the proper setting.

[7] **VERIFY** that the cotter pins have been reinstalled in the clevis pins.

[8] **ENSURE** 1/4 inch solid plug removed from reservoir and 1/4 vent plug reinstalled.

NOTES

1) Reference Illustration 2 for Bergen-Paterson, Anchor/Darling and Fronek torque requirements.
2) Reference Illustration 4 for Grinnell tightening requirements.

[9] **TORQUE** or **TIGHTEN** fasteners as required. **RECORD** the torque data on Attachment 4 Data Sheet.

Attachment 1
(Page 8 of 18)

Removal and Reinstallation of Hydraulic Snubbers

Date ________

2.2 Structural Mounted Units

NOTE
For units **NOT** having struts for adjustment, the method of adjusting the unit is through extension or compression of the piston rod.

[1] Prior to the installation of the unit, **CHECK** that piston rod is at the "As-Found" position setting or approximately 1 inch less than the "As-Found" position setting as recorded on Attachment 4 Data Sheet.

[2] **ENGAGE** the piston rod in the threaded adapter until it is tight and aligned properly.

[3] **CHECK** for the required overall pin-to-pin dimension.

[4] **USE** a chain fall, block and tackle, or similar method to secure and raise the unit for installation as necessary.

[5] **ORIENT** snubber end attachment and **BOLT** in place.

[6] **INSERT** clevis pins in the appropriate clevis.

[6.1] **IF** piston rod extends too far, **PERFORM** the following:

[6.1.1] **PUSH** or **PULL** on the piston rod, as required, to obtain the proper position setting,

OR

[6.1.2] To relieve the spring force and subsequent fluid pressure in the accumulator housing (1), **THREAD** the 5/16-18 NC rod with nut and two flat washers into the indicator rod (5) (Min. 1/2-inch) and **TIGHTEN** until resistance is felt on the indicator plunger (5) indicating compression of the accumulator spring (13a).

[6.1.3] **ADJUST** piston rod to the proper setting.

[7] **VERIFY** cotter pins have been reinstalled in the clevis pins.

Attachment 1
(Page 9 of 18)

Removal and Reinstallation of Hydraulic Snubbers

Date ________

2.2 Structural Mounted Units (continued)

NOTES

1) Reference Illustration 2 for Bergen-Paterson, Anchor/Darling and Fronek torque requirements.
2) Reference Illustration 4 for Grinnell tightening requirements.

[8] **TORQUE** or **TIGHTEN** fasteners as required. **RECORD** data on Attachment 4 Data Sheet.

NOTES

1) Due to the internal fluid pressure caused by the spring-loaded piston in the accumulator, the piston rod will slowly extend when **NOT** restrained.
2) The minus 1 inch setting will allow for this growth during the time the unit is being reinstalled at its location.

[9] **OBTAIN** the "As-Left" position setting. **RECORD** the value on Attachment 4 Data Sheet.

[10] At the end of each installation, **CHECK** each unit as a precaution for the following information.

A. Snubber Serial Number.

B. Piston rod extension dimension.

C. Fluid level indicator reading.

D. Whether or not fluid was added to bring unit to proper level.

E. Visible condition of the unit.

Attachment 1
(Page 10 of 18)

Removal and Reinstallation of Hydraulic Snubbers

Date ________

2.2 Structural Mounted Units (continued)

F. Condition of the strut assembly with particular attention to the clamp and the bolting tightness.

G. Cotter pins installed in clevis pins.

[11] **IF** the snubber is subject to moisture, high humidity, or vibration, **GREASE** the end attachment spherical bearings as required with GP-2 (or equivalent).

[12] **COMPLETE** Attachment 4 Data Sheet, and **SUBMIT** to the Snubber Engineer/designee for final evaluation.

2.3 Installation of Lisega Type 30 Snubbers

NOTES

1) The sightglass is located in a brass alloy housing near the back end of the snubber body.
2) The leading edge of the reservoir piston acts as the fluid level indicator.
3) When the reservoir is full, the sightglass will show the silver color of the stainless steel cylinder tube.
4) When there is a loss of fluid, the brass alloy (gold color) reservoir piston will appear in the sightglass, either partially or completely.

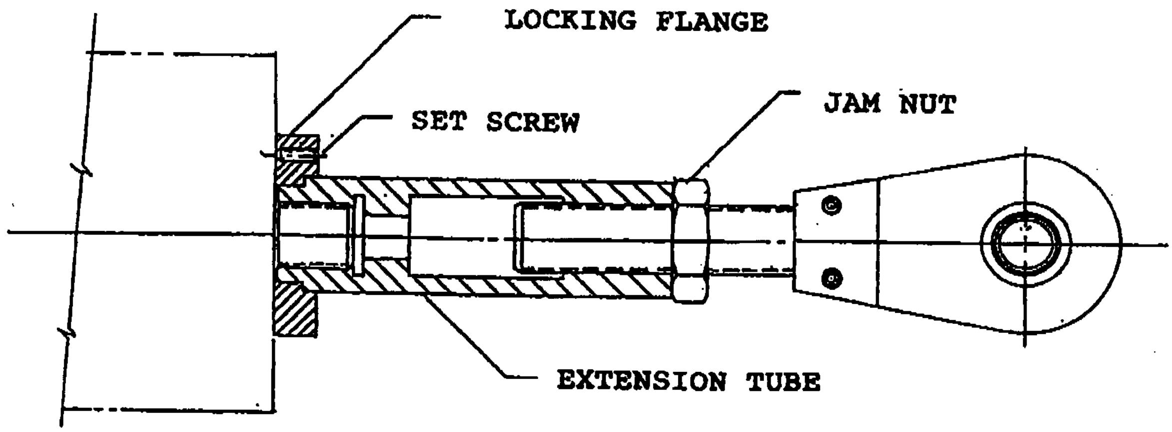
[1] **EXTEND** snubber to proper installation position as follows:

[1.1] **STROKE** snubber slowly to avoid activating snubber.

Attachment 1
(Page 11 of 18)

Removal and Reinstallation of Hydraulic Snubbers

2.3 Installation of Lisega Type 30 Snubbers (continued)



[1.2] **IF** snubber becomes activated, **REVERSE** direction.

[2] **IF** an extension strut is required, **PERFORM** the following:

[2.1] For Type 3018 snubbers, **BOLT** extension strut at rear flange. **TORQUE** bolts to 22 in-lbs. **RECORD** data on Attachment 4 Data Sheet..

[2.2] For Type 3038 through 3092 snubbers, **THREAD** strut directly onto threaded stud protruding from rear plate of snubber.

[2.2.1] **TIGHTEN** extension strut until locking flange firmly contacts rear plate of snubber.

Attachment 1
(Page 12 of 18)

Removal and Reinstallation of Hydraulic Snubbers

2.3 Installation of Lisega Type 30 Snubbers (continued)

[2.2.2] **TORQUE** set screw in locking flange to rear plate of snubber in accordance with the following table. **RECORD** data on Attachment 4 Data Sheet.

Snubber Type	Set Screw (ft-lbs)
3038	3
3042	3
3052	7
3062	7
3072	19
3082	28
3092	28

NOTES

1) Exercise care **NOT** to move snubber from the proper installed position (cold) during handling.
2) Small adjustments (1/4 inch or less) may be made to align pin holes and spherical bearings.
3) For extended pin-to-pin assemblies, adjustment of up to 1-1/2 inches may be made using the extension strut.
   - This is accomplished by loosening the lock nut and threading the paddle end in or out of the extension tube.
   - A circumferential thread relief in the male threads of the paddle end will indicate minimum thread engagement with the extension tube. This thread relief should not extend beyond the extension tube.

[3] **INSTALL** snubber assembly.

[4] **ROTATE** snubber side to side to check for proper lug alignment and absence of binding.

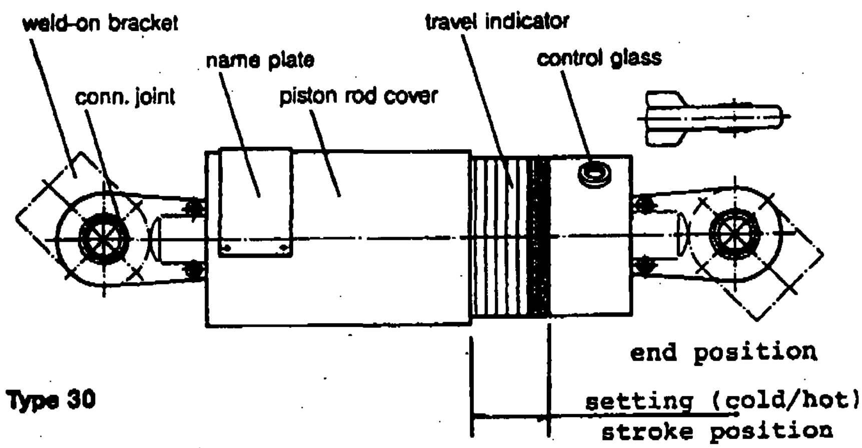
Attachment 1
(Page 13 of 18)

Removal and Reinstallation of Hydraulic Snubbers

2.3 Installation of Lisega Type 30 Snubbers (continued)

[5] **ENSURE** threaded connections are secure.

[6] **OBTAIN** the "As-Left" position setting. **RECORD** the value on Attachment 4 Data Sheet.



Attachment 1
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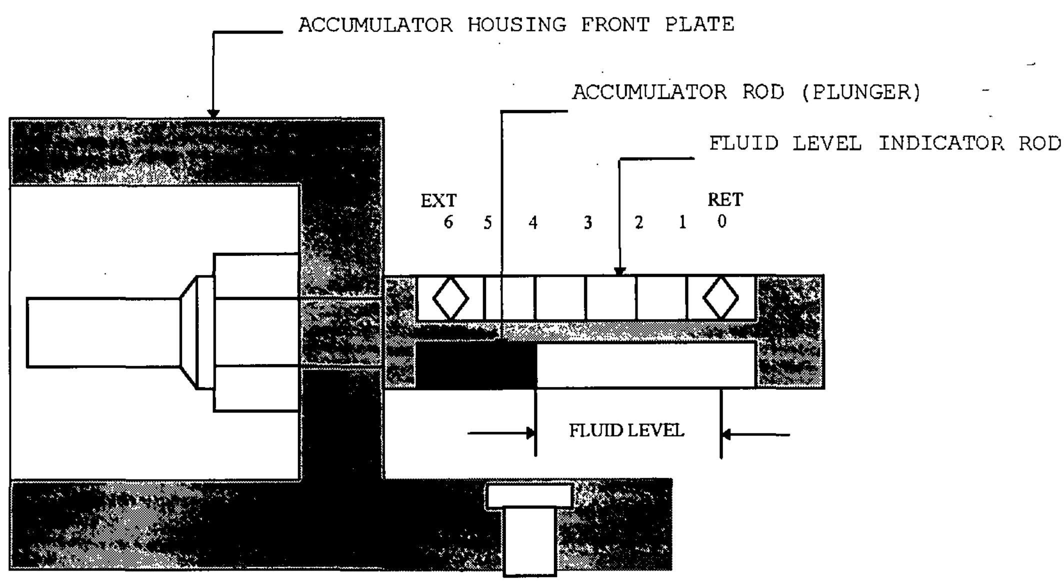
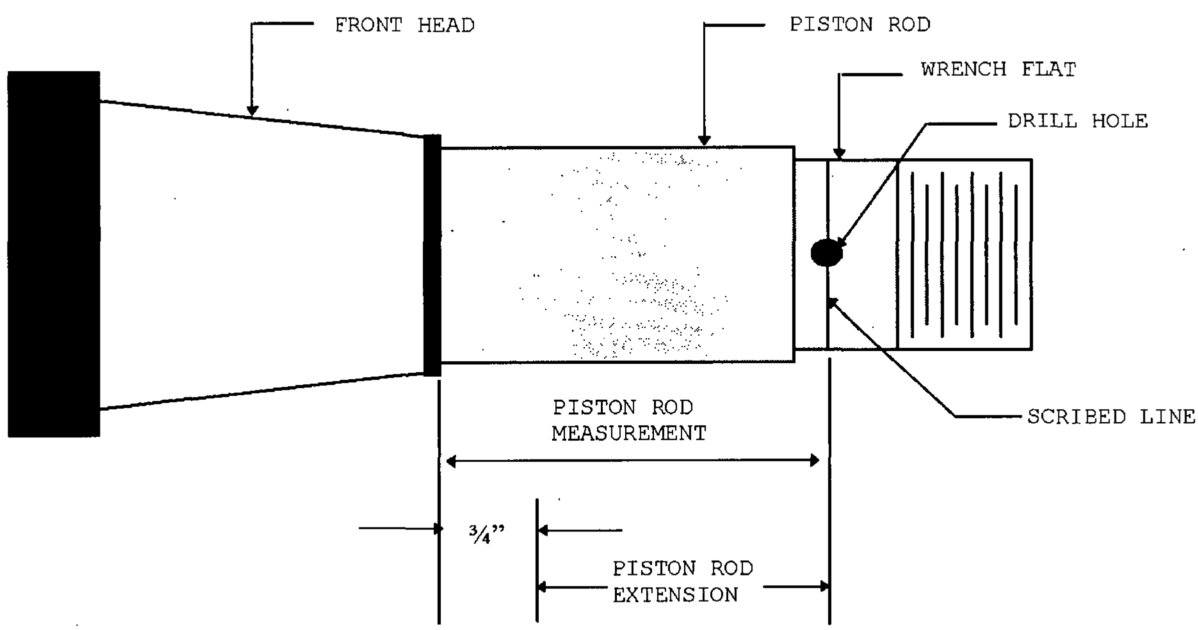
Removal and Reinstallation of Hydraulic Snubbers

2.4 Ilustrations

Illustration 1
BERGEN-PATERSON, ANCHOR/DARLING, FRONEK FLUID LEVEL INDICATOR/PISTON ROD MEASUREMENT





Attachment 1
(Page 15 of 18)

Removal and Reinstallation of Hydraulic Snubbers

2.4 Ilustrations (continued)

Illustration 2

Bergen - Paterson, Anchor/Darling and Fronek Hydraulic Snubber Bloting Guide

Bolting information for mounting flanges on Bergen-Paterson, Anchor/Darling and Fronek Hydraulic snubbers.

Snubber Size	Bolt	Material	Required Torque (1)
HSSA-3	3/8-16	SA307 GR. A	6 FT-LBS
HSSA-10	1/2-13	SA307 GR. A	25 FT-LBS
HSSA-20	5/8-11	SA325	70 FT-LBS
HSSA-30	5/8-11	SA325	100 FT-LBS
ADH-300	3/8-16	SA307 GR. A	6 FT-LBS
ADH-1000	1/2-13	SA307 GR. A	25 FT-LBS
ADH-2000	5/8-11	SA325	70 FT-LBS
ADH-3000	5/8-11	SA325	100 FT-LBS
ADH-5000	7/8-9	SA325	225 FT-LBS
ADH-7000	1-8	SA325	290 FT-LBS
ADH-13000	1-3/8-6	SA325	650 FT-LBS

(1) The bolts should be torqued to ± 10 percent of the values shown above.

Attachment 1
(Page 16 of 18)

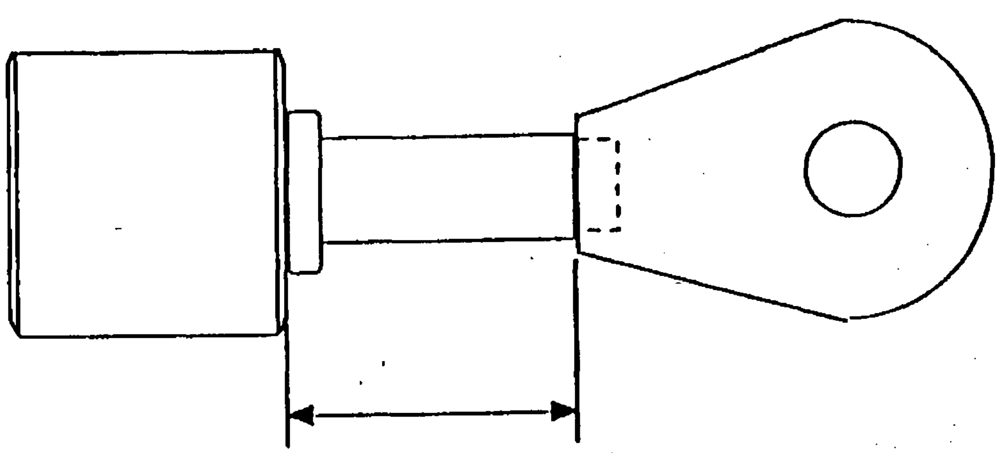
Removal and Reinstallation of Hydraulic Snubbers

2.4 Ilustrations (continued)

GRINNELL HYDRAULIC SNUBBER

ILLUSTRATION 3

PISTON ROD POSITION MEASUREMENT



Attachment 1
(Page 17 of 18)

Removal and Reinstallation of Hydraulic Snubbers

2.4 Ilustrations (continued)

Illustration 4

Grinnell Hydraulic Snubber Bolting Guide

Bolting information for mounting flanges on Grinnell Hydraulic snubbers.

Snubber Size	Bolt	Material	Required Tightness (1)
1-1/2	3/8-24x1-1/4	SA307 GR. A	Snug Tight
2-1/2	3/8-24x1-1/4	SA307 GR. A	Snug Tight
3-1/4	1/2-20x1-1/2	SA307 GR. A	Snug Tight
3-1/2	1/2-20x1-1/2	SA307 GR. A	Snug Tight
4	5/8-18x1-3/4	SA307 GR. A	Snug Tight

(1) The bolts should be tightened snug tight without additional nut rotation.

Snug tight is the condition of tightness that exists when all of the parts of the joint are in firm contact. This tightness may be achieved by an unmodified commercial open-end wrench or a sprocket type ratchet.

Attachment 1
(Page 18 of 18)

Removal and Reinstallation of Hydraulic Snubbers

2.4 Ilustrations (continued)

REMARKS: ____

Attachment 2
(Page 1 of 6)

Removal and Reinstallation of Mechanical Snubbers

NOTES

1) The early version of the PSC snubbers was finished with a white epoxy enamel exterior coating. The later version of the snubbers has a zinc-cadmium-chromate stabilized plating.
2) The standard size of the spherical bearing on the PSA-10 snubbers was changed from 7/8 inch to 1 inch on the later version. However, the later version can be furnished with the 7/8 inch spherical bearing.
3) Removal/Reinstallation of snubbers is to be performed generally in accordance with the following steps. The steps may be performed out of sequence as required to best facilitate the flow of work.
4) Document removal and reinstallation data for the snubber on Attachment 4 Data Sheet, Removal and Reinstallation of Snubbers.

1.0 REMOVAL OF PACIFIC SCIENTIFIC MECHANICAL SNUBBERS

NOTES

1) Care should be exercised to catch the spacers as the pin or stud is removed.
2) The snubbers through size PSA 10 may be easily operated by hand to extend or retract, as necessary, to ease removal of the snubber. For sizes PSA-35 and -100, both pivot pins will require removal, and rigging should be used as necessary to support the snubber.
3) The foreman should record the diameter of the pivot pin from the PSA-10 snubbers as either 7/8 inch or 1 inch in the remarks section of the Attachment 4 Data Sheet, as a reminder when reinstalling the snubber.
4) When exchanging of an end plug is required on an existing PSA 10 with 7/8 inch diameter pins to a PSA 10 with 1 inch diameter pins, refer to Attachment 7 for instructions.

[1] **PERFORM** visual inspection of the snubber for any visible damage and freedom of movement.

[1.1] **IF** visible damage or difficulty of movement are discovered, **NOTIFY** the Snubber Engineer/designee to evaluate the condition in accordance with Attachment 6.

Attachment 2
(Page 2 of 6)

Removal and Reinstallation of Mechanical Snubbers

Date ________

1.0 REMOVAL OF PACIFIC SCIENTIFIC MECHANICAL SNUBBERS (continued)

[2] **ENSURE** snubber attachment fasteners are **NOT** loose or missing prior to unpinning the snubber(s).

[2.1] **IF** loose or missing attachment fasteners are discovered, **NOTIFY** Snubber Engineer/Designee to initiate a Problem Event Report (PER) in accordance with SPP-3.1, Corrective Action Program, and evaluate the condition in accordance with Attachment 5.

NOTE
The position setting is the measured distance from the housing lip to the edge of the position indicator tube.

[3] **RECORD** the "As-Found" position setting on Attachment 4 Data Sheet.

[3.1] **IF** the "As-Found" position setting is not legible, **THEN**

MEASURE the "As-Found" position setting in accordance with Illustration 1 to the nearest 1/8 inch. **RECORD** the value on Attachment 4 Data Sheet.

[4] **REMOVE** cotter pin(s) from the end of the clevis pins.

[5] **USE** a chain fall, block and tackle, or similar method to secure and lower the unit for removal as necessary.

[6] **REMOVE** the pivot pins from the end attachments and/or pipe as required.

[7] **TRANSPORT** the unit to the designated testing area after it has been decontaminated, if required.

Attachment 2
(Page 3 of 6)

Removal and Reinstallation of Mechanical Snubbers

Date ________

2.0 REINSTALLATION OF PACIFIC SCIENTIFIC MECHANICAL SNUBBERS

NOTE

If practical, the snubber should be reinstalled such that the position setting may be read from a convenient location.

[1] **USE** a chain fall, block and tackle, or similar method to secure and raise the unit for installation as necessary. **CHECK** the alignment of the snubber with its rear bracket and/or pipe clamp.

[2] **ENSURE** snubbers which are oriented vertically are reinstalled such that the base of the housing assembly is up to avoid accumulation of moisture in the base housing of the snubber.

CAUTION

Do **NOT** twist or rotate the snubber shaft. Damage to the internal parts will result if the snubber is rotated, one end relative to the other end.

[3] **ORIENT** snubber end attachment and **BOLT** in place, if required. **USE** Illustration 2 for torquing requirements. **RECORD** the torque data on Attachment 4 Data Sheet.

[4] **APPLY** anti-seize thread lubricant to the surface of the pivot pins and to all threaded fasteners that are being installed.

[5] At the end of each installation, **CHECK** each unit for the following information.

A. Snubber Serial Number.

B. Piston rod extension dimension.

C. Visible condition of the unit.

Attachment 2
(Page 4 of 6)

Removal and Reinstallation of Mechanical Snubbers

Date ________

2.0 REINSTALLATION OF PACIFIC SCIENTIFIC MECHANICAL SNUBBERS (continued)

D. Cotter pins installed in clevis pins.

E. Gaps between the spacers and the spherical bearing is 1/16 inch or less.

[6] **OBTAIN** the "As-Left" position setting. **RECORD** the value on Attachment 4 Data Sheet.

NOTE
The "As-Left position setting should be the same as the "As-Found" position setting if they are measured identically both times. However, it should be recorded in the remarks section of Attachment 4 Data Sheet, if it is different.

[7] **COMPLETE** Attachment 4 Data Sheet, and **SUBMIT** to the Snubber Engineer/Designee for final evaluation.

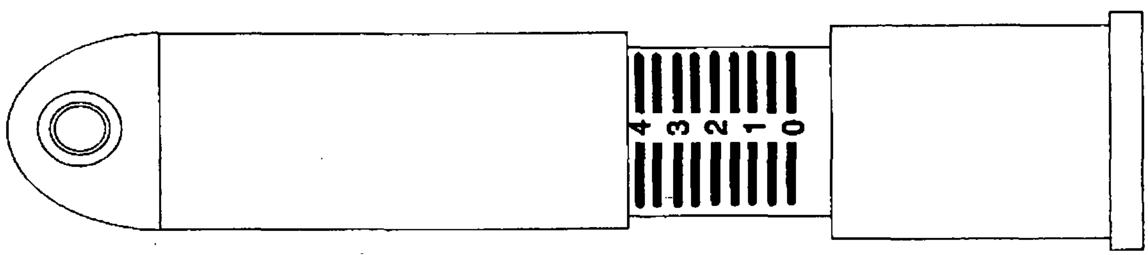
[8] **IF** the snubber is subject to moisture, high humidity, or vibration, **GREASE** the end attachment spherical bearings as required with GP-2 (or equivalent).

Attachment 2
(Page 5 of 6)

Removal and Reinstallation of Mechanical Snubbers

2.0 REINSTALLATION OF PACIFIC SCIENTIFIC MECHANICAL SNUBBERS (continued)

ILLUSTRATION 1



Attachment 2
(Page 6 of 6)
Removal and Reinstallation of Mechanical Snubbers

2.0 REINSTALLATION OF PACIFIC SCIENTIFIC MECHANICAL SNUBBERS (continued)

Illustration 2

Size	Spacers (5)	Cotter Pin	Pivot Pin	Stud Bolt (1)
PSA-1/4	1/2 x 3/8 x 1/16	1/8 x 1	3/8 x 2	3/8 x 2, 2-1/4, 2-1/2
PSA-1/2	1/2 x 3/8 x 1/16	3/8 x 1	3/8 x 2	3/8 x 2, 2-1/4, 2-1/2
PSA-1	5/8 x 1/2 x 1/16	1/8 x 1	1/2 x 2	1/2 x 2-3/4, 3, 3-1/4
PSA-3	7/8 x 3/4 x 1/16	1/8 x 1-1/2	3/4 x 2-1/2	3/8 x 4-1/2, 4-3/4, 5
PSA-10	1 x 7/8 x 1/16	3/16 x 2	7/8 x 2-3/4	7/8 x 4, 4-1/4, 4-3/4, 5, 5-1/4, 5-1/2, 6
PSA-35	1-7/8 x 1-1/2 x 3/16	1/4 x 2-3/4	1-1/2 x 4-3/8	1-1/2 x 9-1/4, 9-3/4
PSA-100	2-7/8 x 2-1/2 x 1/2	3/8 x 4	2-1/2 x 7-3/8	2-1/2 x 15-5/8

Size	Stud Nut	Snubber End Attachment Bolts	Indicator Tube Bolts (1)	Snubber End Attachment Bolt Torque
PSA-1/4	3/8- 16 UNC	10 - 24 X 3/4	N/A	22 +/-2 in-lb
PSA-1/2	1/2- 13 UNC	10 - 24 X 3/4	N/A	22 +/-2 in-lb
PSA-1	1/2- 13 UNC	1/4 - 20 X 1	8 - 32 X 1/4	45 +/-5 in-lb
PSA-3	3/4- 13 UNC	5/16- 24 X 1-1/4	10 - 32 X 1/4	120 +/-10 in-lb
PSA-10	7/8- 9 UNC	1/2 - 13 X 1-1/2	10 - 32 X 5/16	37 +/-2 ft-lb
PSA-35	1-1/2-6 UNC	N/A	1/2 - 28 X 1/2	N/A
PSA-100	2-1/2-4 UNC	N/A	5/16 -24 X 5/8	N/A

Size	Rod Ext. Nut	Pliers (2)	Safety Wire	Size of Telescope Cylinder	Snap Ring
PSA-1/4	1/2 - 13 UNC	S - 6500	0.032	3/4	N5002 - 200 MD
PSA-1/2	1/2 - 13 UNC	S - 6500	0.032	3/4	N5002 - 200 MD
PSA-1	3/4 - 10 UNC	S - 6700	0.032	1	N5002 - 312 MD
PSA-3	1-1/4 - 7 UNC	S - 6700	0.032	2	N5002 - 412 MD
PSA-10	1-1/2 - 6 UNC	S - 6700	0.032	2-1/2	N5002 - 500 MD
PSA-35	2-1/2 - 4 UNC	N/A	N/A	4	N/A
PSA-100	N/A	N/A	N/A	4	N/A

NOTES

1) Head Drilled for lock wire.
2) *Retains support cylinder in housing assembly sizes through PSA 10.*
3) Size of hydraulic snubber which uses the same size attachments.
4) Browns Ferry has early version with 7/8" ball bushing and is now special order. (new standard is 1" diameter).
5) The spaces (A) between the spaces/washers of the bracket assemblies or pipe clamp shall NOT allow more than 1/16 inch of lateral movement of the spherical. bearing. Spacers/washers may be added, as necessary, to ensure this maximum gap is maintained.

Attachment 3
(Page 1 of 14)

Removal and Reinstallation of Bergen-Paterson or Lisega Torus Dynamic Restraints

NOTE
Document removal and reinstallation data for the snubber on Attachment 4 Data Sheet, Removal and Reinstallation of Snubbers. Steps may be performed out of sequence as required to best facilitate the flow of work.

1.0 REMOVAL OF BERGEN-PATERSON OR LISEGA HYDRAULIC TORUS DYNAMIC RESTRAINTS (TDR)

[1] **PERFORM** visual inspection of the snubber visible damage or fluid leakage. **RECORD** the observed condition on Attachment 4 Data Sheet.

[1.1] **IF** visible damage or fluid leakage are discovered, **NOTIFY** the Snubber Engineer to evaluate the condition in accordance with Attachment 6.

[2] **ENSURE** the visual examination has been performed prior to the removal of the snubber.

[3] **ENSURE** snubber attachment fasteners are **NOT** loose or missing prior to unpinning the snubber(s).

[3.1] **IF** loose or missing attachment fasteners are discovered, **NOTIFY** the Snubber Engineer to initiate a Problem Event Report (PER) in accordance SPP-3.1, Corrective Action Program, and evaluate the condition in accordance with Attachment 5.

[4] **MEASURE** the "As-Found" position setting in accordance with Illustration 1A. **RECORD** the value on Attachment 4 Data Sheet, to the nearest 1/8 inch.

Attachment 3
(Page 2 of 14)

Removal and Reinstallation of Bergen-Paterson or Lisega Torus Dynamic Restraints

Date ________

1.0 REMOVAL OF BERGEN-PATERSON OR LISEGA HYDRAULIC TORUS DYNAMIC RESTRAINTS (TDR) (continued)

NOTES
1) For Bergen-Paterson, the piston position setting may be obtained by measuring from the face of the rod head to the beginning of the taper on the rod near the wrench flats and subtracting 1/16 of an inch. See Illustration 1A.
2) For Lisega, the piston rod extension is the distance(X)from the front head of the snubber to the outside edge marked on piston rod (nearest 1/8 inch), as shown on Illustration 1B: Record on Attachment 4 Data Sheet.
3) For Lisega, reservoir plunger reading (L) is the reading from the rear plate to the end of the plunger rod (nearest 1/8 inch), as shown on Illustration 1B. Record on Attachment 4 Data Sheet.
4) For Lisega, **RECORD** the “As-Found” position of the 2-way ball valve on Attachment 4 Data Sheet.
5) If the lifting and stroke positioning fixtures are to be used, perform Steps 1.0[5] thru 1.0[7].
6) If the lifting and stroke positioning fixtures are **NOT** used, perform Steps 1.0[8] thru 1.0[8.4].
7) For testing purposes only the upper pin of the restraint is required to be removed, unless the restraint is required to be completely removed to perform the test.

[5] **POSITION** the lifting fixture on the front head by removing the top adjustment bolt and spreading its arms apart.

[5.1] **CLOSE** fixture arms around the restraint's front head, making sure the fixture's tabs fit flush against the restraint's front head.

[5.2] **REPLACE** the top adjustment bolt, but do **NOT** tighten.

Attachment 3
(Page 3 of 14)

Removal and Reinstallation of Bergen-Paterson or Lisega Torus Dynamic Restraints

Date ________

1.0 REMOVAL OF BERGEN-PATERSON OR LISEGA HYDRAULIC TORUS DYNAMIC RESTRAINTS (TDR) (continued)

[6] **ASSEMBLE** the stroke positioning fixture as shown on Illustration 2, as follows:

[6.1] **THREAD** the Enerpac cylinder into the cylinder mounting bracket, making sure that the Enerpac cylinder has full thread engagement into the mounting bracket.

[6.2] **CONNECT** the hydraulic hoses to the Enerpac cylinder.

[6.3] **TURN ON** the power unit and **STROKE** the Enerpac cylinder piston rod out 2-1/2 inches from its fully retracted position.

[7] **INSTALL** the stroke positioning fixture onto the Torus Dynamic Restraint front clevis per Illustration 3 and the following:

[7.1] **ATTACH** the cylinder/bracket assembly onto the rod clevis round.

[7.2] **TORQUE** the 1-1/4 inch - 7 (cap screw Illustration 3) to 350 FT-LB. The orientation of the cylinder/bracket assembly should be 90 degrees from the perpendicular and in line with the trunnion threaded hole.

NOTE

The lifting fixture may require alignment with the cylinder/bracket assembly to enable the load rod to thread into the trunnion.

[7.3] **INSERT** the load connection rod and **THREAD** it through the Enerpac threaded collar (Illustration 3).

[7.4] **TORQUE** the top adjustment bolt on the lifting fixture to 50 ft-lbs.

Attachment 3
(Page 4 of 14)

Removal and Reinstallation of Bergen-Paterson or Lisega Torus Dynamic Restraints

Date ________

1.0 REMOVAL OF BERGEN-PATERSON OR LISEGA HYDRAULIC TORUS DYNAMIC RESTRAINTS (TDR) (continued)

[8] **IF** the stroke positioning fixture is not to be used, **THEN**

PERFORM the following:

[8.1] **INSTALL** an eye bolt into one of the tapped holes in the locknut.

[8.2] **ATTACH** nylon lifting straps or chokers to previously installed eyebolts.

[8.3] **ATTACH** nylon lifting straps or chokers around the body of the restraint to replace the lifting fixture.

[8.4] With two Come-A-Longs or chain falls, **RELIEVE** the restraint's weight by pulling upward on the lifting strap(s) with a force of approximately 1800 pounds.

[9] If the freeze fit pins have already been removed **PROCEED TO** Step 1.0[13].

[10] With the restraint being held in place by the Come-A-Long or chain fall, **SET UP** the drill rig for the removal of the freeze fit pins.

[11] **DRILL** the pin out.

[12] **ENSURE** the snubber setting is **NOT** disturbed while unpinning the snubber before testing, if possible.

Attachment 3
(Page 5 of 14)

Removal and Reinstallation of Bergen-Paterson or Lisega Torus Dynamic Restraints

Date ________

1.0 REMOVAL OF BERGEN-PATERSON OR LISEGA HYDRAULIC TORUS DYNAMIC RESTRAINTS (TDR) (continued)

[13] **REMOVE** the Special 4 Inch Tapered Two Piece Pins as follows:

[13.1] **REMOVE** the 1/2 inch cotter pin from the end of the tapered pin and slotted nut.

[13.2] Using a wrench on the head of the pin to restrain the pin, **LOOSEN** slotted nut.

[13.3] **BACK OFF** the nut until there is approximately 1/2 inch clearance between the washer and the shoulder of the pin.

[13.4] Using a brass plate or similar device to protect the slotted nut, **TAP** the brass plate to break loose the self-locking taper of the pin and sleeve.

CAUTION
Do **NOT** allow the threads of the pin to contact and gouge the sleeve.

[13.5] **REMOVE** the slotted nut and washer from the pin and **REMOVE** the pin from the sleeve.

Removal and Reinstallation of Bergen-Paterson or Lisega Torus Dynamic Restraints

Date ________

2.0 REINSTALLATION OF BERGEN-PATERSON OR LISEGA DYNAMIC RESTRAINTS

NOTES

1) It is preferred to reinstall the unit in the same restraint assembly, using the identification mark. Using units of similar bore and stroke is possible at any given location, but should be done on a case-by-case basis under the direction of the Snubber Engineer or designee.
2) The permanent spacer washers on the end attachments may be filed smooth in order to facilitate installation of the end piece of the Lisega dynamic restraint.
3) Prior to rigging a Lisega snubber into place verify pin-to-pin dimensions of snubber and attachments to ensure they match and adjust snubber's length as required. For adjustment instructions see Steps 2.0[9.1] thru 2.0[9.4].

[1] **PERFORM** the following:

[1.1] **INSERT** the short alignment pin into the torus wall bracket.

[1.2] **INSERT** the torus dynamic restraint bottom paddle between the torus wall bracket.

[1.3] **INSERT** the special 4 inch tapered two piece pin as directed by Step 2.0[8] into the torus wall bracket.

[1.4] **SWING** the front clevis down between the torus bracket ears.

NOTE

If the test machine is attached to the restraint it may be used to adjust the restraint for repining and Steps 2.0[2] thru 2.0[6] may be omitted.

[2] **CONNECT** the hydraulic hoses from the Enerpac power unit to the Enerpac cylinder.

Attachment 3
(Page 7 of 14)

Removal and Reinstallation of Bergen-Paterson or Lisega Torus Dynamic Restraints

Date ________

2.0 REINSTALLATION OF BERGEN-PATERSON OR LISEGA DYNAMIC RESTRAINTS (continued)

[3] **INSERT** the short alignment pin into one of the torus ears (tapered end first).

[4] **TURN** the power unit on and **EXTEND** the restraints' stroke out until the alignment pin slides freely through both the ball bushing and the opposite torus ear.

[5] Once the temporary pin is inserted, **DISCONNECT** the hydraulic hoses and **UNTHREAD** the 1-1/4 inch - 7 UNC load rod from the trunnion until the 1-1/4 inch - 7 UNC screw is accessible.

[6] **REMOVE** the cap screw and bracket/cylinder/load rod.

[7] **ENSURE** the restraint is completely restrained.

[8] **INSTALL** the Special 4 Inch Tapered Two Piece Pins as follows:

[8.1] **DISASSEMBLE** the tapered pin assembly.

[8.2] **APPLY** a thin film of lubricant to the 0D of the sleeve and to the threads and tapered surface of the pin. **USE** Never Seez Pure Nickel, Neolube 1 or 2, Felpro C5-A Nuclear Grade, Fel-Pro N-7000 or G.E. Silicone Grease, G-351.

[8.3] **VERIFY** the bore of the bracket and the bearing are free of burrs, rust, and debris.

[8.4] **INSERT** the tapered pin in the thin end of the sleeve until the threaded portion of the pin is such that the slotted nut can be started.

[8.5] **PLACE** a wrench on the pin head to restrain the pin while tightening the slotted nut.

Removal and Reinstallation of Bergen-Paterson or Lisega Torus Dynamic Restraints

Date ________

2.0 REINSTALLATION OF BERGEN-PATERSON OR LISEGA DYNAMIC RESTRAINTS (continued)

[8.6] **TORQUE** both slotted nuts of both special 4 inch tapered two piece pins to 100 ft-lbs. Otherwise, **TORQUE** the upper paddle special 4 inch tapered two piece pin to 100 ft-lbs.

[8.7] **BACK** the nut off only enough to align a set of slots in the nut with the first available hole.

[8.8] **INSERT** the cotter pin(s) in the hole(s). **SPREAD** the cotter pin(s) enough to prevent falling out.

[9] **OBTAIN** the "As-Left" position setting. **RECORD** the value on Attachment 4 Data Sheet.

NOTES

1) For Bergen-Paterson, the piston position setting may be obtained by measuring from the face of the rod head to the beginning of the taper on the rod near the wrench flats and subtracting 1/16 of an inch. See Illustration 1A.
2) For Lisega, the piston rod extension is the distance(X)from the front head of the snubber to the outside edge marked on piston rod (nearest 1/8 inch), as shown on Illustration 1B: Record on Attachment 4 Data Sheet.
3) For Lisega, the reservoir plunger reading (L) is the reading from the rear plate to the end of the plunger rod (nearest 1/8 inch), as shown on Illustration 1B: Record on Attachment 4 Data Sheet.
4) If the torus dynamic restraint (Lisega or Bergen-Paterson) piston is at the end of its stroke it may be necessary to adjust the piston length. This may be performed on the snubber installed in the plant without removing the installation pins. This adjustment is performed under the direction of the Snubber Engineer/Designee utilizing the following steps.

Lisega

Attachment 3
(Page 9 of 14)

Removal and Reinstallation of Bergen-Paterson or Lisega Torus Dynamic Restraints

Date ________

2.0 REINSTALLATION OF BERGEN-PATERSON OR LISEGA DYNAMIC RESTRAINTS (continued)

[9.1] **LOOSEN** the hex head bolts on the end attachment paddle 1-2 turns to allow the piston to be turned.

[9.2] Using a spanner wrench or other suitable tool, **TURN** the piston clockwise to lengthen the piston or counter clockwise to shorten the piston.

[9.3] **ADJUST** piston to provide 1/8" to 1/4" of reserve travel as determined by the Snubber Engineer/Designee.

[9.4] **RE-TIGHTEN** the hex head bolts on the end attachment paddle after desired piston adjustment is completed.

Bergen-Paterson

[9.5] **LOOSEN** lock nut on the end attachment paddle.

[9.6] Using an open end wrench, **TURN** the piston clockwise to lengthen the piston or counter clockwise to shorten the piston.

[9.7] **ADJUST** piston as determined by the Snubber Engineer/Designee.

[9.8] **RETIGHTEN** the lock nut on the end attachment paddle after desired piston adjustment is completed.

Attachment 3
(Page 10 of 14)

Removal and Reinstallation of Bergen-Paterson or Lisega Torus Dynamic Restraints

Date ________

2.0 REINSTALLATION OF BERGEN-PATERSON OR LISEGA DYNAMIC RESTRAINTS (continued)

[10] At the end of each installation, **CHECK** each unit as a precaution for the following information:

- Snubber Serial Number.
- Piston rod extension dimension.
- Fluid level indicator reading.
- Whether or **NOT** fluid was added to bring unit to proper level.
- Visible condition of the unit.
- Condition of the strut assembly, with particular attention to the clamp and bolting tightness.
- Cotter pins installed in clevis pins.

[11] For Lisega Torus Dynamic Restraints, **VERIFY** the 2-way ball valve positioner is in the vertical position. **RECORD** on Attachment 4 Data Sheet.

[12] **IF** the snubber is subject to moisture, high humidity, or vibration, **GREASE** the end attachment spherical bearings with a high-quality grease (such as GP-2, etc.) for this application.

[13] **COMPLETE** Attachment 4 Data Sheet, and **SUBMIT** to the Snubber Engineer/designee for final evaluation.

Attachment 3
(Page 11 of 14)

Removal and Reinstallation of Bergen-Paterson or Lisega Torus Dynamic Restraints

2.0 REINSTALLATION OF BERGEN-PATERSON OR LISEGA DYNAMIC RESTRAINTS (continued)

ILLUSTRATION 1A - BERGEN-PATERSON

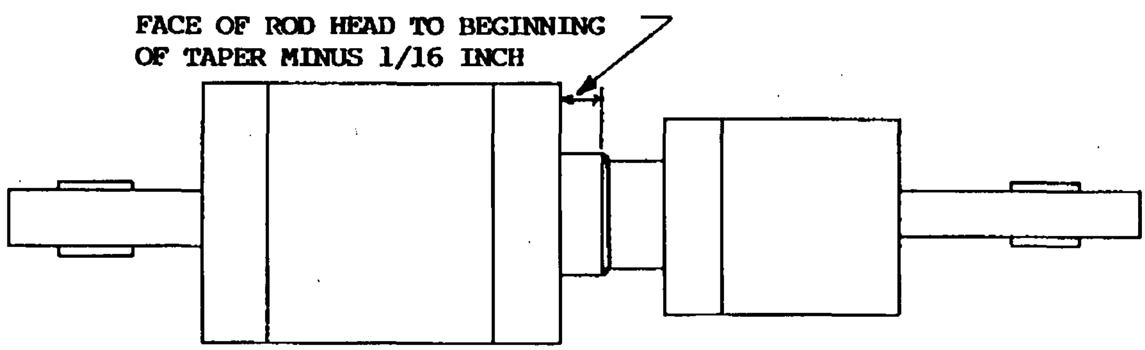
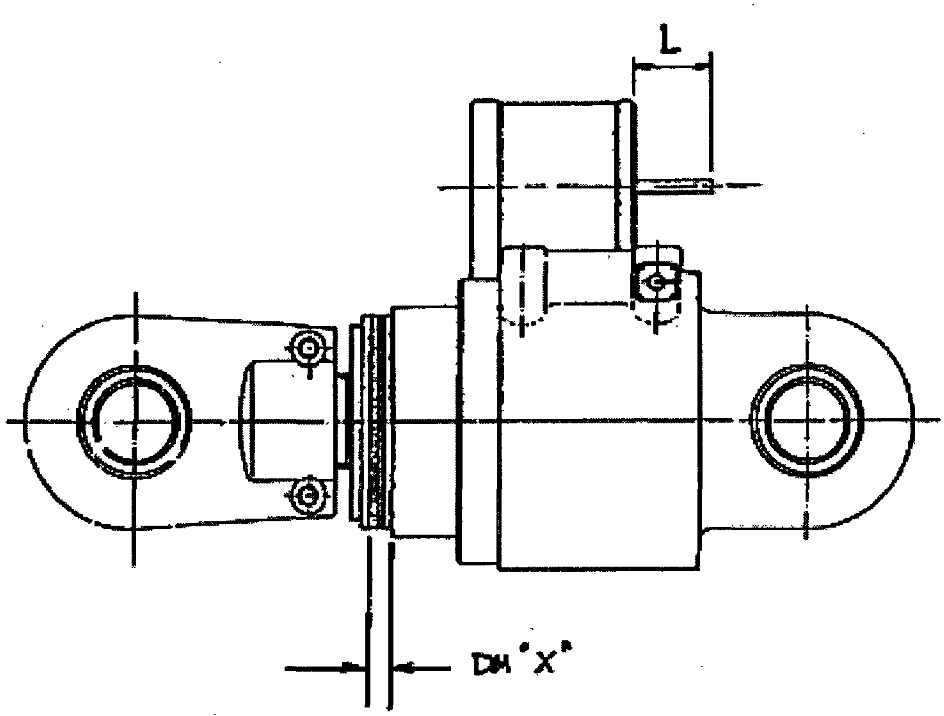


ILLUSTRATION 1B - LISEGA



Attachment 3
(Page 12 of 14)

Removal and Reinstallation of Bergen-Paterson or Lisega Torus Dynamic Restraints

2.0 REINSTALLATION OF BERGEN-PATERSON OR LISEGA DYNAMIC RESTRAINTS (continued)

Lisega Minimum and Maximum Fluid Level Plunger and Piston Position Measurement In The Field.

Nomenclature:

X - Measurement of the snubber piston rod position in inches from the front head of the snubber to the outside edge marked piston rod.

L Minimum - The minimum fluid level in the reservoir using the reservoir piston rod position measured from the front of the reservoir to the end of the reservoir piston rod.

L Maximum - The maximum fluid level in the reservoir using the reservoir piston rod position measured from the front of the reservoir to the end of the reservoir piston rod.

If the X measurement is between the values given in the table below for "X", then **GO TO** the next lower reading for "X" to determine the L Minimum and L maximum.

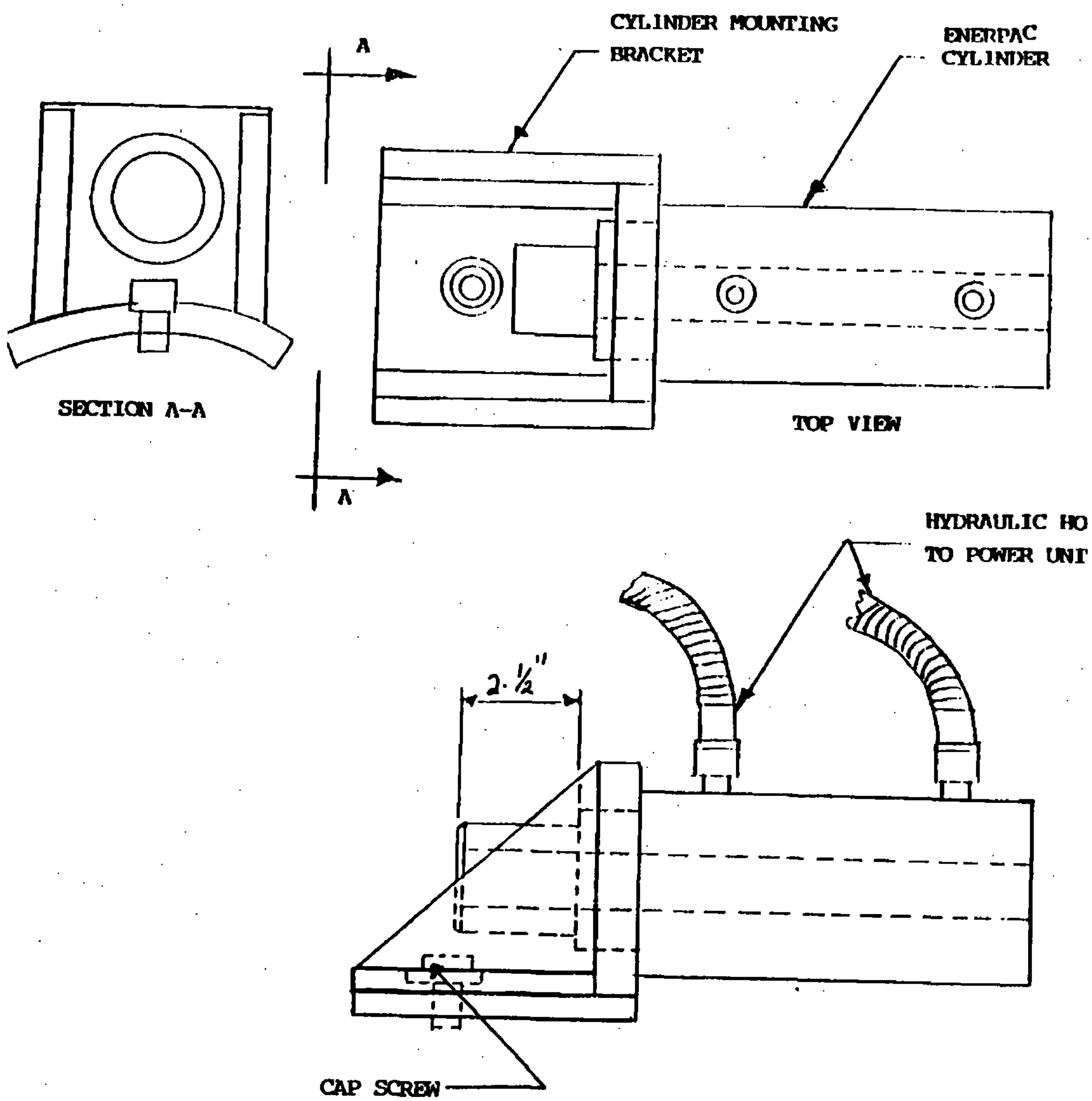
X (INCHES)	L MINIMUM (INCHES)	L MAXIMUM (INCHES)
0.000	2.52	3.31
0.125	2.43	3.22
0.250	2.34	3.13
0.375	2.26	3.04
0.500	2.17	2.96
0.625	2.08	2.87
0.750	1.99	2.78
0.875	1.91	2.69
1.000	1.82	2.60
1.125	1.73	2.52
1.250	1.64	2.42
1.375	1.55	2.34
1.500	1.47	2.25

Attachment 3
(Page 13 of 14)

Removal and Reinstallation of Bergen-Paterson or Lisega Torus Dynamic Restraints

2.0 REINSTALLATION OF BERGEN-PATERSON OR LISEGA DYNAMIC RESTRAINTS (continued)

Illustration 2

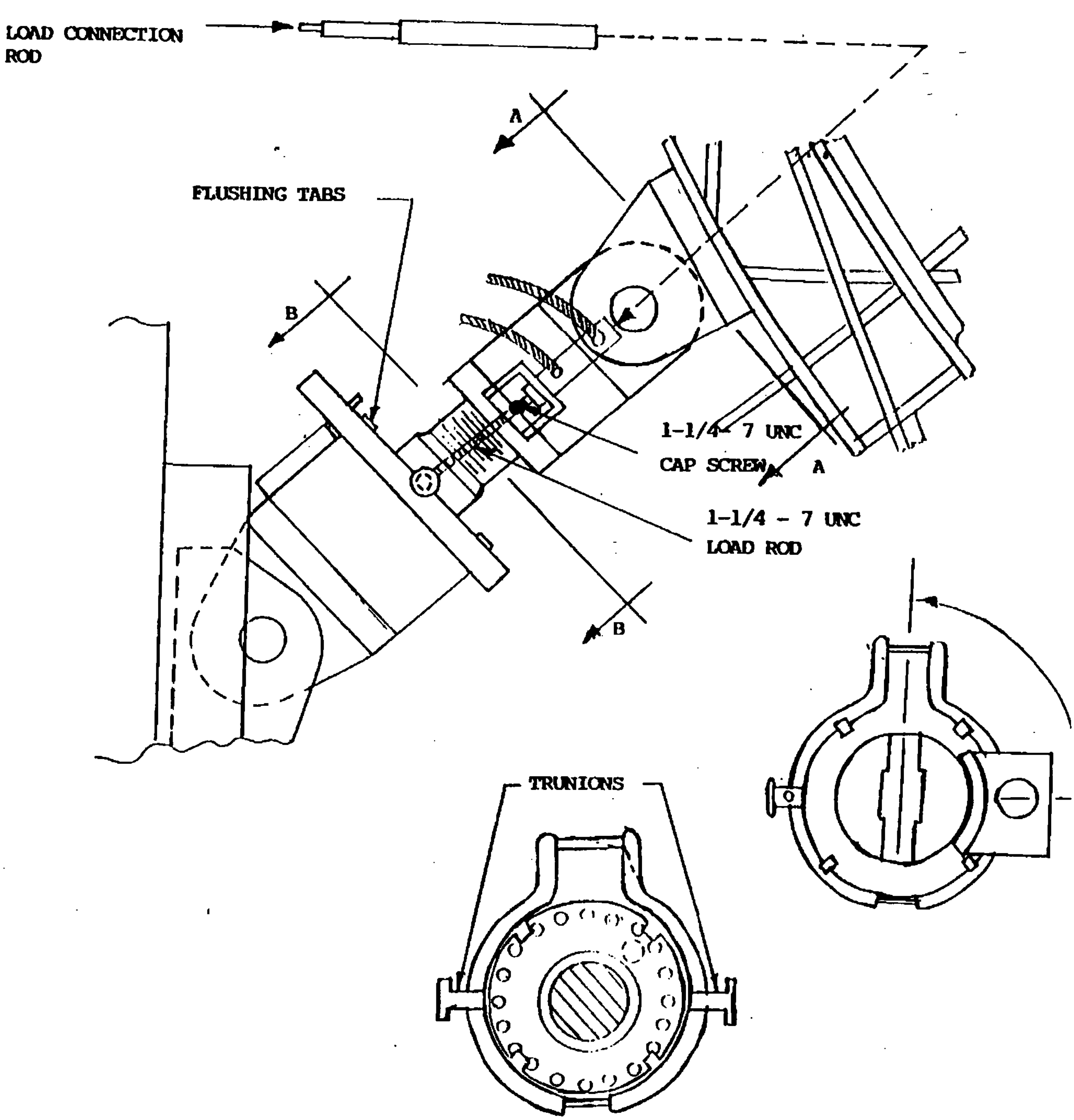


Attachment 3
(Page 14 of 14)

Removal and Reinstallation of Bergen-Paterson or Lisega Torus Dynamic Restraints

2.0 REINSTALLATION OF BERGEN-PATERSON OR LISEGA DYNAMIC RESTRAINTS (continued)

ILLUSTRATION 3



Attachment 4
(Page 1 of 3)

Data Sheet

Snubber Type:__________

Unit____ Cycle____ WO #________ Snubber UNID #________

Snubber S/N________(removed) Snubber S/N________(installed)

Instruction	Performer	Signature/Date
Unit Supervisor Notified of Snubber Removal Time________ Name____________	Foreman/Designee	
REMOVAL		
Visible Damage of Snubber Found: ___YES ___NO	Craftsman	
Fluid Leakage from Snubber Found: ___YES ___NO	Craftsman	
Freedom of Movement for Mechanical Snubber: ___YES ___NO	Craftsman	
Loose or Missing Fasteners: ______YES ______NO	Craftsman	
Mechanical Position Indication Reading "As-Found" Reading:________	Craftsman	
Bergen-Paterson, Anchor/Darling, Fronek Hydraulic Record Readings: AF Index/Plunger:__________ AF Piston:____________ -3/4 =__________ (Actual Piston Reading) AF Index/Plunger - Actual Piston Reading = ____________ (Fluid Level)	Craftsman	
Grinnell Hydraulic AF Piston Measurement:________ *Fluid Level Acceptable:____YES____NO *Reservoir should be approx. half full.	Craftsman	
Lisega Type 30 AF Reading: __________	Craftsman	
Bergen-Paterson Torus Dynamic Restraint Index / Piston Reading - "As-Found": Record Readings: AF Index(Plunger):________ AF Piston:________ -1/16 = ________	Craftsman	

Attachment 4
(Page 2 of 3)

Data Sheet

Instruction	Performer	Signature/Date
Lisega Torus Dynamic Restraint Piston Rod Position X - "As-Found": Record Reading:________	Craftsman	
Lisega Torus Dynamic Restraint Reservoir Plunger L - "As-Found": Record Reading:________	Craftsman	
Lisega Torus Dynamic Restraint 2-Way Ball Valve - "As-Found": Record Position:____________	1st/2nd Party	________ / _____
REINSTALLATION		
Snap ring seated or Telescoping tube nut torqued Torque Wrench: M&TE No. _____________ Cal. Due Date________	Line Verifier ______________ Craftsman	________ / _____
Torque of Base Plate Bolts or Threaded Extension Connector Torque Wrench: M&TE No. ____________ Cal. Due Date________	Line Verifier _______________ Craftsman	________ / _____
Fasteners & Pins Secure	Craftsman	
Mechanical Position Indication Reading "As-Left" Reading:________	Craftsman	
Bergen-Paterson, Anchor/Darling, Fronek Hydraulic Record Readings: AL Index/Plunger:__________ AL Piston:______________ -3/4 =__________ (Actual Piston Reading) AL Index/Plunger - Actual Piston Reading = _____________(Fluid Level)	Craftsman	
Grinnell Hydraulic AL Piston Measurement:________ *Fluid Level Acceptable:____YES____NO *Reservoir should be approx. half full.	Craftsman	

Attachment 4
(Page 3 of 3)

Data Sheet

Instruction	Performer	Signature/Date
Torque of Type 3018 Extension Strut Bolts Torque Wrench: M&TE No. ___________ Cal. Due Date________	Line Verifier ______________ Craftsman	________ / _____
Torque of Type 3038 - 3092 Locking Flange Set Screw. Torque Wrench: M&TE No. ___________ Cal. Due Date________	Line Verifier ______________ Craftsman	________ / _____
Lisega Type 30 AL Reading: __________	Craftsman	
Bergen-Paterson Torus Dynamic Restraint Index / Piston Reading - "As-Left": Record Readings: AL Index(Plunger):________ AL Piston:________ -1/16 =________	Craftsman	
Lisega Torus Dynamic Restraint Piston Rod Position X - "As-Left": Record Reading:________	Craftsman	
Lisega Torus Dynamic Restraint Reservoir Plunger L - "As-Left": Record Reading:________	Craftsman	
Lisega Torus Dynamic Restraint 2-Way Ball Valve - "As-Left": Record Position:___________	1st/2nd Party	________ / _____
Fluid Level Reading Acceptable	Craftsman	
Bolts and Jam Nuts Torqued Torque Wrench: M&TE No. ___________ Cat. Due Date________	Line Verifier ______________ Craftsman	________ / _____
Unit Supervisor Notified Snubber Reinstalled Time______ Name________	Foreman/Designee	

Remarks: ____

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Attachment 5
(Page 1 of 1)

Evaluation of Loose or Missing Attachment Fasteners

NOTE

This evaluation shall be performed only when fasteners, used for attachment of snubber(s) to component and to snubber anchorage, are discovered loose or missing prior to the "As-Found" functional testing.

Snubber Type____________ Unit________ Serial No. ________
Snubber UNID No. ________________ PER No.________
Subgroup______________ Size________

1. Describe the discovered condition(s): ____________________________________

2. If possible, determine cause: ____________________________________

3. Evaluate to determine whether the cause may be localized or generic. Use this evaluation to select and list other suspect snubbers for verifying attachment fasteners, as applicable.

4. Describe the corrective action(s) and provide the "As-Found" test results.

Evaluated by: ____________________ ____________
Snubber Engr./Designee Date

Attachment 6
(Page 1 of 2)

Engineering Evaluation of Unacceptable Indication

Unit________ Snubber UNID No. ________ Serial No. ________
Exam No._____ Manuf. ________ Size________ PER No.________

1. Describe the unacceptable indication(s) observed. ______________________________

2. What is the cause of the indication(s) (i.e., vibration, water leaking on surface, possible failure to torque at last reinstallation, etc.)?

3. What is the basis for the conclusions reached by question 2 above?

4. Which additional snubbers are suspected to be subject to the same unacceptable indication(s)?

Attachment 6
(Page 2 of 2)

Engineering Evaluation of Unacceptable Indication

Unit________ Snubber UNID No. ________ Serial No. ________

Exam No.______ Manuf. ________ Size________ PER No.________

5. What further examination(s) and/or test(s) of the snubber(s) are to be performed?

____

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6. What are the results of the examination(s) and/or test(s) performed by Step 5 above, and what changes in the initial evaluation should be made?

____

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7. What corrective action(s) is/are to be taken for the initial snubber and/or any other suspect snubbers?

____

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____

8. Has/have the corrective action(s) been taken? ______________________

Evaluated by: ______________________ ____________

Snubber Engr./Designee Date

Attachment 7
(Page 1 of 2)

Instructions for Exchanging the Snubber End Plug

NOTES
1) These instructions are applicable to PSA 10 mechanical snubbers.
2) These instructions are to be followed when an existing PSA 10 mechanical snubber with a 7/8 inch diameter pin is replaced with a PSA 10 mechanical snubber with a 1 inch diameter pin.

1.0 PERFORMANCE

[1] **REMOVE** the fillister head screws and flat washers to free the position indicator tube from the end plug assembly of the old and new snubber.

[2] **REPLACE** screws if distorted or damaged.

[3] **REMOVE** the position indicator tube.

[4] **PLACE** the snubber on an appropriate workbench or stand.

[5] Using an Allen wrench, **REMOVE** the set screws from the end plug assembly.

[6] **REPLACE** screws if distorted or damaged.

[7] **REMOVE** the distorted threads of the telescoping cylinder as needed. A drill size number 23 may be used.

- Drill only to the depth necessary to remove the distortions, allowing the end plug to rotate freely.

[8] **SECURE** the telescoping cylinder to prevent rotation.

[9] **REMOVE** the end plug from each snubber.

[10] **INSTALL** the appropriate end plug on the snubber.

Attachment 7
(Page 2 of 2)

Instructions for Exchanging the Snubber End Plug

Date ________

1.0 PERFORMANCE (continued)

[11] **TORQUE** the end plug to 40 - 60 inch pounds.

Performer ____________________ __________
Signature Date

Final torque applied:________

Line Verifier ____________________ __________
Signature Date

[11.1] **BACK OFF** end plug to achieve proper alignment, if needed.

[12] **COAT** set screw threads with approved retaining compound. **INSTALL** the set screws.

[13] **TORQUE** set screws to 15 - 25 inch pounds.

Performer ____________________ __________
Signature Date

Final torque applied:________

Line Verifier ____________________ __________
Signature Date

[14] **REINSTALL** the position indicator tube over the end plug assembly.

[15] **COAT** fillister screw threads with approved retaining compound. **REINSTALL** the fillister head screws snug tight. Safety wire fillister head screws.

Tennessee Valley Authority
Browns Ferry Nuclear Plant, Unit 2

Relief Request No. 2-ISI-40, Snubbers Inspection and Testing

Relief Request No. 2-ISI-40, Reference E

Browns Ferry Nuclear Plant, Surveillance Instruction, 0-SI-4.6.H-2A,
"Functional Testing of Mechanical Snubbers"

TVA

Browns Ferry Nuclear Plant

Unit 0

Surveillance Instruction

0-SI-4.6.H-2A

Functional Testing of Mechanical Snubbers

Revision 0011

Quality Related

Level of Use: Continuous Use

Effective Date: 09-16-2010

Responsible Organization: DEC, Design Eng Civil

Prepared By: Stephen Samaras

Approved By: Eric J. Frevold

Current Revision Description

Pages Affected: Cover sheet, revision log, 30, and 32.

Type of Change: REVISION 0011 Tracking Number: 012

This revision is to add signoffs and calibration accuracy ranges for M & TE calibrated measurement test equipment and pyrometers as identified by PER 236306. Revised Attachment 2 to incorporate calibration accuracy.

Table of Contents

Table of Contents (continued)

1.0 INTRODUCTION

1.1 Purpose

This Surveillance Instruction implements Technical Requirements Manual (TRM) TR 3.7.4, and provides direction for the functional testing of mechanical snubbers, as given in the Snubber Program Procedure (0-TI-398), on all safety related systems, inside and outside of the drywell.

1.2 Scope

The snubbers within the scope of this instruction are accessible during reactor operation (outside the drywell) and inaccessible during reactor operation (inside the drywell). The Pacific Scientific Company (PSC) mechanical snubbers belong to Subgroups 3a, 3b, 4, and 6.

The portions of Technical Requirements TR 3.7.4 pertaining to the visual examination of snubbers are implemented by Surveillance Instructions 1-SI-4.6.H-1, 2-SI-4.6.H-1, and 3-SI-4.6.H-1.

This Surveillance Instruction (SI) provides the requirements and guidance to perform functional testing of Pacific Scientific mechanical snubbers addressed as PSA-1/4, -1/2, -1, etc. for Units 1, 2, and 3 as follows:

- Removal and reinstallation of Pacific Scientific mechanical snubbers to facilitate testing is accomplished in accordance with MPI-0-000-SNB004 and recorded in Attachment 2 and 5.

- Provides the requirements for functional testing of Pacific Scientific mechanical snubbers. This instruction covers subgroups 3a, 3b, 4 and 6 (see Appendix A for snubber subgroup information). To completely fulfill the snubber Technical Requirements Manual (TRM) functional testing requirements, other Surveillance Instructions, 0-SI-4.6.H-2B, 0-SI-4.6.H-2C, 0-SI-4.6.H-2D, and 0-SI-4.6.H-2E must also be performed as required per TSR 3.7.4.2.

- Provides a means for the control and documentation of all snubber surveillance activities provided in this Surveillance Instruction.

- This Surveillance Instruction shall be used to verify operability of mechanical snubbers suspected inoperable during performance of the visual examination SI's.

- All PSA-1/4 snubbers (inside the drywell) should be stroke tested during each refueling outage, as close to the end of the outage as possible.

1.3 Frequency/Conditions

A. This Surveillance Instruction shall be performed each refueling outage and portions of it may be performed to establish operability in accordance with 1-SI-4.6.H-1, 2-SI-4.6.H-1, and 3-SI-4.6.H-1 Visual Examination of Hydraulic and Mechanical Snubbers.

B. This instruction may be performed at any time for snubbers outside the drywell (preferably no earlier than 60 days prior to the start of the outage), but may only be performed at a time when the drywell may be entered for snubbers inside the drywell.

C. All safety related snubbers shall be operable during all modes of operation as described in the Technical Requirements Manual TR 3.7.4, if the system is required to be operable during that mode.

D. Snubbers located inside the drywell on reactor vessel attached piping shall be OPERABLE whenever fuel is in the reactor vessel. Snubbers on the Main Steam, HPCI, and RCIC piping, in the drywell, are exempt from the operability requirement when safety related, seismically qualified steam line plugs are installed in the reactor vessel. For each Recirculation System Loop, if the associated supported systems are inoperable, snubbers inside the drywell on the Recirculation System, on the RHR System, and on the RWCU System are exempt from the operability requirements provided safety-related, seismically qualified plugs are installed both in the reactor vessel nozzles of the associated Recirculation System Loop supply piping to the Recirculation System pump and the associated Loop discharge nozzles of the Reactor Jet Pumps, and the applicable drain valve BFR-1 DRV-010-0505, BFN-2-DRV-010-0505, or BFN-3-DRV-010-0505 is closed.

E. A snubber removed from an operable safety related system must be reinstalled or replaced within 72 hours of its removal or declare the supported component or system inoperable and follow the appropriate action statement for that system.

F. For an inoperable snubber(s), within 72 hours, replace or restore inoperable snubbers to an operable status and perform an engineering evaluation on the supported component or system, if the snubber does **NOT** meet the functional test acceptance criteria of TSR 3.7.4.2. Otherwise, declare the system inoperable and follow the required actions specified in the TRM.
The engineering evaluation is to determine if the component or system restrained by the snubber(s) was adversely affected by inoperability of the snubber(s) during the previous operating cycle and ensure that the restrained component or system remains capable of meeting its design function. The engineering evaluation(s) for supported component or system analysis are to be documented on Attachment 4.

1.3 Frequency/Conditions (continued)

G. Alternately, for a snubber removed and **NOT** replaced within 72 hours, or an inoperable snubber **NOT** replaced or restored within 72 hours, operability of the supported system may be verified based on an engineering evaluation of the system functional capability with the removed or inoperable snubber.

H. Snubbers removed for maintenance or determined to be inoperable on a non-operable safety related system must be reinstalled or replaced, in accordance with MPI-0-000-SNB004 and tested in accordance with this instruction, prior to declaring the system operable.

I. For all subgroups, when subsequent testing is required, it shall continue within the respective subgroup until no failure is found.

J. New, replaced or rebuilt snubber(s) shall meet the functional test acceptance criteria before their installation in the unit and must have been functionally tested "Satisfactory", within 12 months prior to their installation.

2.0 REFERENCES

A. Technical Requirements Manual, TR 3.7.4 Snubbers.

B. 1-SI-4.6.H-1, Surveillance Instruction Visual Examination of Hydraulic and Mechanical Snubbers.

C. 2-SI-4.6.H-1, Surveillance Instruction Visual Examination of Hydraulic and Mechanical Snubbers.

D. 3-SI-4.6.H-1, Surveillance Instruction Visual Examination of Hydraulic and Mechanical Snubbers.

E. MPI-0-000-SNB004, Instructions for Removing and Reinstalling Pacific Scientific Mechanical, Bergen-Paterson, Anchor/Darling, Fronek, Grinnell Hydraulic and Bergen-Paterson or Lisega Torus Dynamic Restraint Snubbers.

F. BFN-VTM-P029-0010, Pacific Scientific Instruction Manual for Repair, Overhaul, Installation and Maintenance of Mechanical Shock Arrestors.

G. 0-TI-398, Snubber Program Procedure

H. SPP-3.1, Corrective Action Program

I. SPP-8.1, Conduct of Testing.

2.0 REFERENCES (continued)

J. A Snubber Response Sensitivity Study, A. T. Onesto, Energy Technology Engineering Center (ASME Technical Conference Paper PVP-37 "Piping Restraint Effect on Piping Integrity" June, 1979). Reference Engineering Design memorandum to H. J. Green Director of Nuclear Power; From M.N. Spouse Manger of Engineering Design: Dated May 2, 1983 (CEB 83 0502 003)

3.0 PRECAUTIONS AND LIMITATIONS

None

4.0 PREREQUISITES

A. Six months prior to each refueling outage, the supply of mechanical snubbers in Power Stores and the Snubber Rebuild Facility shall be reviewed. A number of snubbers equal to the 10% sample population for the Subgroup selected for functional testing during the upcoming refueling outage shall be identified and available for installation. The snubbers shall have the proper paperwork with them to comply with the requirements of the Section XI Repair and Replacement Program. This paperwork should include the purchase contract and Certificate of Compliance for any material requiring traceability.

5.0 SPECIAL TOOLS AND EQUIPMENT RECOMMENDED

None

6.0 ACCEPTANCE CRITERIA

A. Responses which fail to meet the following As-Found functional test acceptance criteria require immediate notification of the Shift Manager or Unit Supervisor at the time of failure.

B. The snubber functional test shall verify that:

1. "As-Found"

   a. Activation (restraining action) occurs, in both tension and compression. Snubbers with activation values less than or equal to 0.04 g's are acceptable. The measured value shall be rounded to the second decimal place. Activation values greater than 0.04 g's shall be considered as a failure (inoperable snubber), require a failure analysis, and be evaluated for additional scope or expansion testing.

   b. The drag force shall not exceed the maximum acceptable drag force from Table 6.2-1.

2. "As-Left"

   a. Activation (restraining action) occurs, in both tension and compression. Snubbers with activation values less than or equal to 0.02g's are acceptable.

   b. The drag force shall not exceed 3% of the snubber rated load, except for PSA 1/4 the drag force shall not exceed 32.5 lbs.

C. The stroke setting, adjusted for pipe temperature other than ambient if necessary, shall be within the limits shown on the design drawing. Otherwise, complete Attachment 6.

D. There shall be no loose or missing fasteners for attachment of the As-Found mechanical snubber(s) to the component or the anchorage. Otherwise, complete Attachment 6.

6.0 ACCEPTANCE CRITERIA (continued)

E. **NOT** meeting acceptance criteria for the stroke setting, or loose or missing fasteners, does **NOT** require testing an additional lot equal to 10% of that type of snubber. Evaluation of snubber operability, corrective actions, and selection of other suspect snubbers for verification shall be as specified on Attachment 3 or Attachment 6, as applicable.

TABLE 6.2-1
MAXIMUM ACCEPTABLE DRAG FORCE VS. SNUBBER SIZE

SNUBBER SIZE	ACCEPTABLE DRAG FORCE (lbs.)
PSA-1/4 & 1/2 NF	32.5
PSA-1 NF	75.0
PSA-3 NF	300.0

SNUBBER SIZE	ACCEPTABLE DRAG FORCE (lbs.)
PSA-10 PRE- NF	500.0
PSA-10 NF	750.0
PSA-35 NF	2500.0
PSA-100 NF	6000.0

F. "As-Found" drag forces greater than the maximum acceptable drag force from Table 6.2-1 shall be considered as a failure (inoperable snubber), be evaluated for additional or scope expansion testing, and require a supported component or system analysis by Site Engineering Civil, Attachment 4.

G. For snubber(s) specifically required **NOT** to displace under continuous load, the ability of the snubber(s) to withstand load without displacement shall be verified.

7.0 PROCEDURE STEPS

7.1 Training and Qualification of Performers

A. A thorough briefing should be conducted on SI performance prior to starting.

B. The cognizant individual or Snubber Engineer responsible for the performance of the Surveillance Instruction must be qualified as a test director.

C. Appropriate General Employee Training (GET) (including respirator training) should be received by test personnel prior to performing this SI.

D. Training required for the testing of mechanical snubbers shall meet the requirements of Task Number MMY 502.

7.2 Preparation of Test Data Package

[1] **EXCLUDE** the snubbers from the initial test lot (sample plan) which are scheduled for deletion in accordance with approved Design Change Notices.

[2] **EXCLUDE** the snubbers until the next outage from the initial test lot (sample plan) which are to be added in accordance with approved Design Change Notices.

[3] **SELECT** snubbers for retest which were placed in the same location as snubbers which failed during the previous outage, if the failure analysis showed that the failure was due to the location. However, these snubbers shall be tested in addition to the initial 10 percent test lot (sample plan).

[4] **DETERMINE** the initial test lot (sample plan) as follows:

- **SELECT** 10 percent of the snubbers from subgroups 3a, 3b, 4 and 6 (see Appendix A).
- In general, **SELECT** the snubbers with the most time from the previous test.
- Sample should be weighed to include more snubbers from severe service areas (i.e., inside the drywell).
- **SELECT** snubbers that have experienced severe transients.
- **SELECT** snubbers of various sizes.
- If one snubber from a pair of parallel snubbers at the same location along the pipe (restrain in the same direction) is selected for testing the other snubber from that pair also should be selected for testing.

7.2 Preparation of Test Data Package (continued)

[5] **REVIEW** the applicable support drawings to verify the location and any conditions that will require special preparation or equipment.

[6] **REQUEST** scaffold or similar devices to be built, as necessary.

[7] **RECORD** the required information on Attachment 1, and prior to REMOVAL of a snubber per MPI-0-000-SNB004 for functional test, **RECORD** the "As-Found" Stroke Setting in Attachment 2.

7.3 "As-Found" and "As-Left" Functional Test Using the STB 200 Test Bench

[1] **IF** the extension or one of the end attachments has been removed, **THEN**

INSTALL the appropriate end attachments located in the snubber test facility.

[2] **ENSURE** the test bench has been Warmed Up in accordance with Appendix B of this procedure.

NOTE
The following describes a suggested procedure for "Testing a Snubber" using the STB 200 Snubber Test Bench with the upgraded Windows Software Operations Manual.

[3] **POWERING UP THE TEST SYSTEM**

TURN ON the master power switch on the control console. Make sure that the computer, monitor, and printer are turned on. **TURN ON** the main breaker on the Hydraulic Power Unit (HPU) located at the end of the power unit. **ENSURE** that all emergency stop buttons are pulled out.

[4] **STARTING THE SOFTWARE**

Once the computer has "Booted Up", the Windows Desktop will be displayed. **SELECT** the "STB 200" icon and **DOUBLE CLICK** on it, this will Start the Test program. The "LOG ON" prompt window will appear. **ENTER** your user name and password in either upper or lower case letters. All functions required by the system are available in the screen, or from one of the Pull Down Menus at the top of the screen.

[5] **DAILY CALIBRATION CHECK**

PERFORM the Daily Calibration Check using Section 3.0 of Appendix B, and **SIGN** the daily calibration form. After the daily calibration check has been completed, and the Daily Calibration Report is "SATISFACTORY", **PROCEED** on testing a snubber.

7.3 "As-Found" and "As-Left" Functional Test Using the STB 200 Test Bench (continued)

[6] TESTING A SNUBBER

[6.1] Pick the Snubber Type

Using the Snubber Pull Down List in the User Supplied Information block, **SELECT** the Type Snubber to be tested.

[6.2] Enter the Header Information

FILL in the other information as indicated in the User Supplied Information block.

[6.3] Running the Test

[6.3.1] Pick the Test

CLICK on the Type of Test (i.e., "As-Found" or "As-Left") desired.

[6.3.2] Start the Test

CLICK on the Start Test button. If this is the first test performed on the snubber, the following two windows will appear:

[6.3.3] Tare weight Window

This window allows the User to "zero out" any offset load that the load cell may be reading. This should be DONE BEFORE installing the snubber in the test bench. **WAIT** for the "Raw Reading" to settle (as far as possible), and then **CLICK** "Adjust Load Cell". The "Adjustment" will be updated, and the "Adjusted Reading" should now read close to zero (0) lb. The "Adjust Load Cell" button may be Clicked again if a new adjustment value is desired.
Once the readings are as desired, **CLICK** the "Continue" button.
ENSURE the correct load cell is connected to the machine.
CHOOSE the proper bushings and pins for the snubber being tested, then **INSTALL** the bushings in both clevis attachments on the machine.

7.3 "As-Found" and "As-Left" Functional Test Using the STB 200 Test Bench (continued)

[6.3.4] **Stroke and Position Window**

INSTALL the snubber in the test bench, with the piston or operable end toward the drive piston of the machine if possible. **ADJUST** the backstop and or **USE** the Jog Speed Slider to adjust the bench and the driver cylinder to the desired pin to pin dimension. The jog slider adjusts the jog speed. The joystick on the test frame controls the actual motion of the driver. **INSTALL** the pins through the bushing and the snubber spherical bearings.

ONCE the snubber has been pinned, the snubber's piston position (distance from the fully retracted position) should be accurately measured (within 0.1 inch) and entered in the SNUBBER EXTENSION window.

If the test program calculates that it cannot fully extend or fully retract the snubber during drag testing, one or more of the text windows on the screen will be highlighted in red. If this happens, the backstop will have to be adjusted and the snubber extension recalculated. The program calculates whether it can fully test the snubber through its stroke range. It will display the two ends of stroke (minus the 1/2" safety zones), the calculated center position and the bottomed out position for the snubber.

Once the data has been successfully entered, **TIGHTEN** the lock nuts on the load cell threaded rod snug tight to prevent slippage during the test.

ENTER the snubber number, system number, serial number, and test equipment information on Attachment 2 or 5 as required, and **CLICK** on "Continue with Test" to continue the test.

7.3 "As-Found" and "As-Left" Functional Test Using the STB 200 Test Bench (continued)

[6.3.5] **If an Activation Test is Selected**

After all the above steps has been completed, and PRIOR to starting an "As - Found" Activation Test, the test program will initiate a routine to set and stabilize the hydraulic system pressure at a calculated level sufficient to achieve the requested test load. During this period, the set point and actual pressures are displayed, along with the output voltage, and a "count down" value. When the pressure is near the desired value, the countdown value will decrement towards zero. If the pressure fluctuates out of limits, the countdown will reset to six. Once the pressure is stable enough to let the countdown complete, the test will begin automatically.

OBSERVE that the snubber activates in both directions, to establish operability of the snubber in the "As-Found" condition.

RECORD all necessary information on Attachment 2 or 5, as appropriate.

NOTE
Forcing a test may allow the machine to overstress the snubber during the test!

If the user wishes to force a test, clicking the "Force the Test" button will initiate the test regardless of pressure.

Clicking the "Abort the Test" button will cause the test cycle to abort without performing the test.

7.3 "As-Found" and "As-Left" Functional Test Using the STB 200 Test Bench (continued)

[6.3.6] **If Drag Test is Selected**

If a Drag Test (i.e., ID, AC, and FD test sequence for the "As-Left", and ID, AC, FD test sequence for "As - Found" functional test) is selected, the test system will automatically begin the drag test. The system will determine the starting position of the snubber, and choose the initial test direction to move towards the farthest end of stroke. The drag speed will be automatically controlled to the target speed set earlier. This test is to VERIFY free travel of the piston rod through its full stroke, and that the Raw Test Data graphed in real time.

VERIFY that the drag force of the snubber is less than the values shown in Table 6.2-1.

RECORD this information on Attachment 2 or 5, as appropriate.

[6.3.7] **Printing the Results**

After the test is complete, the calculations appropriate to that test are performed and the results are displayed on the screen. This allows the user to review and determine if the "As-Found" test results meet the "As-Left" acceptance criteria in Section 6.0B, and plot the test results:

IF the results are within the "As-Left" acceptance range, **THEN**

CLICK on the "Print Test" button to open the standard Windows printer dialog box. **SELECT** the proper printer, and **CLICK** "OK" to start the printing.

ATTACH the Printed Results in Attachment 2 or 5, as part of the work package.

IF the test results are **NOT** within acceptable range, **THEN**

DO **NOT** start printing or saving the test results. **PROCEED TO** Step 7.3[8] below.

For Activation tests on acceleration limiting snubbers only, the calculated acceleration lines will be printed if they are displayed on the graph when printing is requested.

7.3 "As-Found" and "As-Left" Functional Test Using the STB 200 Test Bench (continued)

[6.3.8] **Saving the Test Results**

To save a test file to disk, **CLICK** the "Save Test" button. This saves the test results in the "test_data" directory. The file name of the saved test result is as follows:
Work_Order_number Serial_number Test_Date Test_Type.csv

Where:
Work_Order_number is the value entered in the work order number entry
Serial_number is the value entered in the serial number entry
Test_Date is the date when test was performed
Test_Type is **ID_** for initial drag tests, **AC** for activation tests and **FD** for final drag tests.
Tests are saved as comma separated variable files and may be directly loaded into Excel or similar spreadsheet programs as desired.

[6.3.9] **Running Another Test**

CLICK on the Type of test to be performed. The results of the last test will be erased, and the graph will rescale for the test to be done.

REPEAT the procedure from Step 7.3[6.3.2] to **COMPLETE** Running Another Test (i.e., the "As-Left"), as needed.

[6.3.10] **Testing Another Snubber**

SELECT a new snubber type, if necessary, from the snubber pull down list. If a snubber of the same type is to be tested, the user has to only change the serial number, hanger number, and work order entries.

REPEAT this procedure from Step 7.3[6.3.1] to **COMPLETE** Testing Another Snubber.

7.3 "As-Found" and "As-Left" Functional Test Using the STB 200 Test Bench (continued)

NOTES

1) At this time the machine has completed Running the Test. Unless you are leaving the building, leave the machine running so it will **NOT** have to be warmed up to perform another test (i.e., the "As-Left" test) as needed.

2) Do **NOT** shutdown the console power without exiting Windows properly.

[6.4] **Quitting and Shutting Down the System**

TURN OFF the 480Vac power on the HPU. On the computer screen, **SELECT** EXIT from the File Menu. When the Windows95 screen appears, **CLICK** on START, then SHUTDOWN, and **CLICK** on SHUT DOWN the Computer. Then **CLICK** OK. When the computer has completely shutdown, **TURN OFF** the main power switch on the current control consoles.

[7] **ENTER** the information on Attachment 2 or Attachment 5.

[8] **DETERMINE** if the "As-Found" test results meet the acceptable criteria in Section 6.0B.

[9] **IF** a snubber is determined to be inoperable, **THEN**

- **NOTIFY** the Shift Manager or Unit Supervisor immediately.
- **REQUEST** a failure analysis using Attachment 3 and a supported component or system analysis on Attachment 4, as necessary.
- **DETERMINE** the subsequent test lot (sample plan), as required.
- **SELECT** the number of snubbers equal to 10 percent of the remaining snubbers in that subgroup.
- In general, **SELECT** the snubbers with the most time from the previous test.
- **FILL OUT** the applicable sections of Attachment 2 as required.
- **ENSURE** test data package is ready for Shift Manager/Unit Supervisor authorization.
- **PERFORM** applicable functional test for the subsequent test lot (sample plan).

7.4 Results Evaluation

NOTE
The following reviews are usually performed by the Snubber Engineer/SE-Designee, or a representative of Site Engineering Civil:

[1] **REVIEW** all of the test data on Attachment 2 or 5, as applicable.

[2] If any snubber is determined to have been inoperable:

- **ENSURE** the Shift Manager/Unit Supervisor has been notified of the inoperable snubber.
- **ENSURE** that a PER has been initiated in accordance with SPP-8.1 and SPP-3.1.
- **INITIATE** a Work Order (WO) to replace the snubber, if necessary.
- **PERFORM** a failure evaluation of any inoperable snubber(s) and **DOCUMENT** on Attachment 3.
- **PERFORM** the supported system or component evaluation on Attachment 4, if required.
- **SELECT** subsequent test lot(s), as required for functional test failure, or other snubbers for verification, as specified on Attachment 6.

7.5 Data Sheet Review

[1] **VERIFY** all of the necessary attachments are included and all acceptance criteria have been met.

[2] **REVIEW** the completed SI package for final acceptance.

NOTE
Computer generated data sheets containing information regarding the initial test lot, subsequent test lots, rebuild, etc., should be submitted with the SI data package.

[3] **SUBMIT** the completed package for closure.

8.0 APPENDIX/ATTACHMENTS

Appendix A - Subgrouping of Mechanical Snubbers

Appendix B - Daily Startup Procedures For The STB-200 Test Bench

Appendix C - PSA Mechanical Snubber Rated Load

Appendix D - Common Modes of Snubber Failure and Possible Causes

Appendix E - Instructions For Exchanging the End Plug From Old to New Snubber

Attachment 1 - Surveillance Instruction Review Form

Attachment 2- Test Data for Removed and Reinstalled Snubber Using the STB-200 Test Bench

Attachment 3 - Engineering Failure Analysis for Inoperable Snubbers

Attachment 4 - Supported System/Component Analysis for Inoperable Snubber

Attachment 5 - Test Data for New, Replacement, or Rebuilt Snubber Using STB-200 Test Bench

Attachment 6 - Evaluation of Loose or Missing Attachment Fasteners, or of "As-Found" Stroke Setting Outside of Acceptable Range

Appendix A
(Page 1 of 2)

Subgrouping of Mechanical Snubbers

1.0 SUBGROUPINGS

For functional testing, mechanical snubbers are divided into four subgroups as described below:

1.1 Subgroups 3a and 3b

These subgroups are based on design features and are composed of medium mechanical snubbers as designed and manufactured by Pacific Scientific Company. They range in capacity from 1500 pounds to 15,000 pounds and are designated as PSA-1, PSA-3, and PSA-10. The design features that set the PSA-1, PSA-3 and PSA-10 mechanical snubbers apart from the small and large mechanical snubbers are the use of a ball screw with a traveling nut that is prevented from rotating by keys traveling in slots. This arrangement is used to transform stroking motion of the snubber into rotation of the inertial mass. These snubbers are divided into subgroups 3a and 3b.

<u>Subgroup 3a</u>

NF design - These snubbers were designed and manufactured in accordance with subsection NF of Section III of the ASME Boiler and Pressure Vessel Code. Materials used for manufacture of the snubber components meet the subsection NF code requirements.

<u>Subgroup 3b</u>

Pre-NF design - These snubbers were designed and manufactured to good commercial practice, **NOT** to the subsection NF code requirements. Materials used for some of the snubber components do **NOT** meet the subsection NF code requirements. Previous functional testing shows that these snubbers have a higher than average failure rate.

Appendix A
(Page 2 of 2)

Subgrouping of Mechanical Snubbers

1.2 Subgroup 4

This subgroup is based on the design features and is composed of Pacific Scientific Company small mechanical snubbers ranging in capacity from 350 pounds to 650 pounds and are designated as PSA-1/4 and PSA-1/2. The design features that set them apart from the other PSA mechanical snubbers are the use of a coarse lead screw and brass nut to transform stroking of the snubber into rotation of the inertial mass. The brass nut has two slots engaged with two small diameter steel rods that prevent rotation of the nut, but permit the nut to travel along the rods as the snubber is stroked. The rods can be bent during sudden overload of the snubber or by rotating the ends of the snubber during installation when the pins in the front end attachment or pipe clamp and the base plate clevis are **NOT** in proper alignment.

1.3 Subgroup 6

This subgroup is based on design features and is composed of large mechanical snubbers as designed and manufactured by Pacific Scientific Company. They range in capacity from 50,000 pounds to 120,000 pounds and are designated as PSA-35 and PSA-100. The PSA-35 and PSA-100 snubbers are equipped with planetary gearing which is **NOT** used in the other sizes. As stated above this arrangement is used to transform stroking motion of the snubber into rotation of the inertial mass.

When snubbers are added, deleted, or changed, based on modifications, they are added or deleted from their appropriate subgroups. If the added snubbers do **NOT** fit an existing subgroup, a revision to this SI describing the new subgroup or a revision to an existing subgroup is required.

Snubbers tested from severe service areas will remain a part of their respective design subgroup, unless a failure analysis is performed and a separate subgroup is justified and incorporated into this SI.

Severe service areas include inside the drywell and in the main steam valve vault room.

There have been minimal failures of snubbers in these locations, therefore, testing 10 percent of the snubbers in these areas each refueling outage satisfies the intent of the surveillance requirement.

Appendix B
(Page 1 of 3)

Daily Startup Procedures for the STB-200 Test Bench

1.0 DAILY STARTUP PROCEDURE

[1] **WARM-UP**

Exercise both benches (i.e., small and large) by selecting the Manual Control Panel function from the Tool Menu. Clicking on "Auto Exercise" in the Operating Mode block will cause the selected bench to automatically stroke back and forth. The system should be run this way until the oil temperature is above approximately 70°F or smooth operation is attained. Both test benches should be exercised. To change from one bench to the other, **CLICK** on the bench label.

[2] **CHECK THE PRESSURE TRANSMITTER**

NOTE
This instrument does **NOT** provide safety-related data. This check is optional.

In the Manual Control Panel mode, **SELECT** Manual in the Operating Mode block. **TURN** the "HP Pump" on, Then **USE** the HP Pump slider to increase the pressure command setting until the "Pressure" reading is approximately 2000 psi. **CHECK** the 0-3000 psi gauge in the front of the HPU. The two readings should be within ~ 200 psi.

[3] **PARK THE RAM**

SELECT the "Park the Ram" to prepare the bench for the Daily Calibration Check. This should be done for both benches.

[4] **SHUT DOWN THE MANUAL CONTROL PANEL**

CLICK on "SHUT DOWN" to exit the Manual Control Panel.

Appendix B
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Daily Startup Procedures for the STB-200 Test Bench

2.0 STATUS CHECK

[1] During the warm-up period, the frame drive cylinders should be stroked using the proportional valve and or the jog/drag valve.

[2] The system should be checked for loose fittings, bolts, etc.

[3] The filter indicators should be watched during cylinder stroking to insure that they are **NOT** illuminating.

[4] If the indicators are illuminating, the filters should be changed before continuing with operation of the machine or any testing.

3.0 DAILY CALIBRATION CHECKS

The following calibration checks assure the functionality of the instrument and the Data Acquisition and Control System (DAS) for testing. They do **NOT** take the place of full system calibrations that must be performed on a periodic basis.

The instrument system (DAS system and transmitters) should be powered up for 30 minutes before any checks or testing is performed.

Prior to performing this function, both rams should have been "Parked" using the "Park the Ram" function in the Manual Control Panel.

[1] **SELECT THE DAILY CALIBRATION FUNCTION**

SELECT the Daily Calibration Check function from the "Tools" menu.

[2] **CONNECT THE LOW RANGE LOAD CELL AS DIRECTED**

If directed to by the software, **ELECTRICALLY CONNECT** the Low Range Load Cell as instructed. The load cell does **NOT** need to be mechanically mounted in the test bench, but it must be connected to its electrical cable.

[3] **STORE THE "ZERO" CALIBRATION READINGS**

For each instrument **CLICK** the "STORE" button in the "ZERO" column on the Daily Calibration screen for that instrument. The zero reading will be captured in the "Actual" "Zero" column. If it is within limits, the box will turn gray. If it is **NOT** within limits, the box will turn yellow.

Appendix B
(Page 3 of 3)

Daily Startup Procedures for the STB-200 Test Bench

3.0 DAILY CALIBRATION CHECKS (continued)

[4] **STORE THE "SPAN" CALIBRATION READINGS**

For each instrument, **PRESS** in the "CAL" button on the front of the instrument, then **CLICK** the "STORE" button in the "SPAN" column on the Daily Calibration screen for that instrument. The span reading will be captured in the "ACTUAL" "SPAN" column. If it is within limits, the box will turn gray. If it is **NOT** within limits, the box will turn yellow.

[5] **PRINT THE REPORT**

When all readings for both benches have been stored, **CLICK** on the "PRINT" button to print the Daily Calibration Report. If the report is "SATISFACTORY", **CONTINUE** the testing. If the report is "UNSATISFACTORY", **HALT** and **CORRECT** the problem before continuing.

Appendix C
(Page 1 of 1)

PSA Mechanical Snubber Rated Load

NOTE

(NF) identifies the later model PSA mechanical snubbers that were designed to ASME, B&PV Code, Section III, Subsection NF.

Model	Rated Load (lbs.)	Stroke Length (in.)
PSA-1/4 (NF)	350	4
PSA-1/2 (NF)	650	2-1/2
PSA-1 (NF)	1500	4
PSA-3 (NF)	6000	5
PSA-10 (NF)	15000	6
PSA-10 (PRE-NF)	10000	6
PSA-35 (NF)	50000	6
PSA-100 (NF)	120000	6

Appendix D
(Page 1 of 1)

Common Modes of Snubber Failure and Possible Causes

TYPE	COMMON MODES OF FAILURE	POSSIBLE CAUSES
Mechanical	Locked in place	Damaged Thrust Bearing Bent Lead Screw Bent Guides Internal Parts Damaged Due To Wear In Service
	High Drag	Internal Parts Damaged Due To Wear In Service Improper Internal Lubrication
	Does **NOT** Activate	Broken Capstan Spring Internal Parts Damaged Due To Wear In Service
	Damage to Snubber Hardware	Improper Reassembly Improper Installation Improper Handling or Abuse Misapplication Overload Vibration or Wear

Appendix E
(Page 1 of 1)

Instructions for Exchanging the End Plug from Old to New Snubber

These instructions are to be followed at any time the end plug is required to be removed from one snubber and placed on a different snubber.

This will most likely take place when a PRE-NF (white) PSA-10 snubber is replaced with a new NF PSA-10 snubber. All of these snubbers are found on the MSRV Tailpipes in the Units 2 and 3 drywells.

When one of these snubbers fails it is to be replaced with a new PSA-10 snubber and the end plug and rear bracket are required to be transferred to the new snubber. This is required because the pin size of the existing snubber is 7/8 inch and the new snubber is 1 inch diameter.

The following instructions are to be followed when exchanging the end plug.

A. **REMOVE** the filister head screws and flat washers to free the position indicator tube from the end plug assembly of the old and the new snubber.

B. If the screws are distorted or damaged **DISCARD** and **REPLACE**.

C. **REMOVE** the position indicator tube.

D. **PLACE** the snubber on a work bench or stand.

E. Using an appropriate Allen Wrench, **REMOVE** the set screws from the end plug assembly.

F. If the screws are distorted or damaged **DISCARD** and **REPLACE**.

G. After removing the set screws, **USE** a size No. 30 drill for a PSA-1 and size No. 23 for a PSA-10, to remove the distorted threads of the telescoping cylinder caused by the set screws.

H. **DRILL** only to the depth necessary to remove the distortions so the end plug assembly can rotate freely.

I. **USE** eye protection, and **REMOVE** any loose drill shavings with clean compressed air.

J. **REMOVE** the end plugs from the snubbers and exchange them as required.

K. **INSTALL** the set screws and **TIGHTEN** to distort the threads on the telescoping cylinder.

L. **REINSTALL** the position indicator tube over the end plug assembly and **REINSTALL** the filister head screws.

Attachment 1
(Page 1 of 1)

Surveillance Instruction Review Form

REASON FOR TEST:

☐ Scheduled Surveillance
☐ System Inoperable (Explain in Remarks) UNIT MODE ______________
☐ Maintenance (WO No. ____________)
☐ Other (Explain in Remarks)

W.O. NO. ______________ SNUBBER UNID ______________ SERIAL NO. ______________

PRE-TEST REMARKS: ________________________________

____

____

PERFORMED BY:

Initials	Name (Print)	Name (Signature)

NOTE: The following entries for contacting Shift Manager/Unit Supervisor shall be marked N/A if the snubber is NOT Inoperable.

NOTIFY Shift Manager/Unit Supervisor when snubber found Inoperable. ________

SM/UNIT SUPERVISOR CONTACTED ______________ Date________ Time ________

NOTIFY Shift Manager/Unit Supervisor when snubber Operability is restored. ________

SM/UNIT SUPERVISOR CONTACTED ______________ Date________ Time ________

MECHANICAL MAINTENANCE REVIEWER ______________ Date ________

Signature attests that I understand the scope and purpose of this instruction and that, to the best of my knowledge, it was properly performed in accordance with instruction in that: the recording, reduction, and evaluation of data is complete and correct; acceptance criteria is met or justification for exceptions is provided; portions of test performed were appropriate for specified test conditions or reasons for test; deficiencies were evaluated and dispositioned; reportability was evaluated; marginal results were evaluated with respect to potential for future problems based on operating experience and regulatory requirements; and instruction was complete except as noted in post-test remarks.

SNUBBER ENGINEER/SITE ENGINEERING CIVIL REVIEWER ______________ Date ________

SCHEDULING COORDINATOR ______________ Date ________

POST-TEST REMARKS: ________________________________

____

____

Attachment 2
(Page 1 of 3)

Test Data for Removed and Reinstalled Snubber Using the STB-200 Test Bench

WO No. ______________ Unit ___ Snubber UNID No. __________ System No. ______
Serial No. ________ Subgroup ______ Initial Test Lot ________ Subsequent ______
Exam No. ________ Size ______ Rated Load ________ Pipe Size ________
Design drawing number _________________________
Shift Manager/Unit Supervisor and Snubber Engineer notified prior to removal of snubber for functional testing.

____________________ ____________ ____________
Foreman/Designee Date Time

As-Found Stroke Setting __________
Required Stroke Setting __________
(from Design drawing)
Pipe Temp.: _____ °F, If other than ambient (per 0-47B435-5F, Note 24), notify Snubber Engineer/Site Engineering Civil.
Pyrometer No.: ________________ Calibration Due Date: ____________

(Calibration Accuracy ± 2° F)

The As-Found Stroke Setting is within the acceptable limits shown in the design drawing listed above.

______ Yes ________ No ____________________ __________ (AC)
Performer Signature Date

All fasteners for the As-Found snubber(s) are secured and acceptable (i.e., no loose or missing fasteners on the component or anchorage).
If the answer is "No", complete Attachment 6.

______ Yes ________ No ____________________ __________ (AC)
Performer Signature Date

Attachment 2
(Page 2 of 3)

Test Data for Removed and Reinstalled Snubber Using the STB-200 Test Bench

WO No. ______________ Unit ___ Snubber UNID No. _________ System No. _____

Snubber Test Data: Record maximum acceptable drag force from Table 6.2-1 ____ Lbs.

As-Found Final Test Results:

Peak Final Drag Forces (lbs.): ________ Tension __________ Compression

The As-Found final drag force in tension and compression meets acceptance criteria based on the allowable load from Table 6.2-1.

_______ Yes _______ No ______________________ __________ (AC)

Performer Signature Date

Activation takes place in both tension and compression and is less than or equal 0.04 g's.

_______ Yes _______ No ______________________ __________ (AC)

Performer Signature Date

Snubber Stroked Full Length Yes No (If No, explain in remarks)

Maintenance reviewer has reviewed the test data to determine whether the snubber meets all of the functional test acceptance criteria. Maintenance reviewer may be the performer of the test or an independent reviewer.

Acceptance criteria satisfied _______ Yes _______ No

______________________ __________

Maintenance Reviewer Date

The Snubber Engineer/SE Designee has performed a second party review of the test data to verify that the snubber meets all of the functional test acceptance criteria. If the response is No (the snubber has **NOT** satisfied the acceptance criteria), specify in remarks actions to be taken:

Acceptance criteria satisfied _______ Yes _______ No

Remarks: ____

____

____

____ __________

SITE ENGINEERING (SNUBBER ENGINEER/SE DESIGNEE) REVIEW DATE

Attachment 2
(Page 3 of 3)

Test Data for Removed and Reinstalled Snubber Using the STB-200 Test Bench

WO No. ______________ Unit ___ Snubber UNID No. __________ System No. ______

Snubber reinstallation:

Same snubber reinstalled	_____ Yes	_____ No	_____ **N/A**
If No, enter serial number (**N/A** if same snubber is reinstalled) and include Attachment 6	Serial Number __________		
Snubber is reinstalled in proper location	_____ Yes	_____ No	_____ **N/A**
Snubber is reinstalled with base of housing up (for vertical snubbers)	_____ Yes	_____ No	_____ **N/A**
All locking devices are secured	_____ Yes	_____ No	_____ **N/A**
Cotter pins are spread	_____ Yes	_____ No	_____ **N/A**
Spherical bearing greased	_____ Yes	_____ No	_____ **N/A**
Gaps between spacers and spherical bearing are 1/16 inch each side, 1/8 inch total or less	_____ Yes	_____ No	_____ **N/A**
Snubber is tagged	_____ Yes	_____ No	_____ **N/A**
Bolts and jam nuts torqued	_____ Yes	_____ No	_____ **N/A**
Anti-seize compound applied, as needed	_____ Yes	_____ No	_____ **N/A**

As-Left Stroke Setting __________

See Attachment 4 of MPI-0-000-SNB004 for Torque Wrench Documentation

______________________ Performer Signature ______________ Date

The As-Left Stroke Setting is within the acceptable limits shown in the Design Drawing as verified.

______ Yes ______ No ______________________ Performer Signature ______________ Date

SHIFT MANAGER/UNIT SUPERVISOR notified of operable and reinstalled snubber.

______________________ Foreman/Designee ______________ Date

Remarks: ____

____

Attachment 3
(Page 1 of 2)

Engineering Failure Analysis for Inoperable Snubbers

WO No. ________________ Unit _______ Snubber UNID No. ______________

Subgroup No. _________ PER No. ______________ Mfg./Size ____________________

Serial No. ____________ Rated Load ___________ Exam No. ________ Lot _______

1. Describe the mode of failure(s), as discussed on Appendix D.

   ☐ Locked up ☐ High Drag Force ☐ Snubber would **NOT** activate
   ☐ Damage to snubber hardware ☐ Other

   Explain (if necessary)

2. Describe the conditions of the failure:

3. Determine the cause of failure, using Appendix D for the possible causes (disassembly of the snubber may be necessary):

4. For a snubber that does **NOT** activate or meet the activation acceptance criteria, release, is locked up, or damaged hardware, was the cause of the failure a design or manufacturing defect?
   ☐ Yes ☐ No

   Explain Evaluation:

Attachment 3
(Page 2 of 2)

Engineering Failure Analysis for Inoperable Snubbers

WO No. ________________ Unit _______ Snubber UNID No. ______________

Subgroup No. _________ PER No. ______________ Mfg./Size ________________

Serial No. ___________ Rated Load ___________ Exam No. ________ Lot ______

5. Snubber Failure classified as: ☐ Location ☐ Manufacturing ☐ Design ☐Unknown ☐ Other
   Describe basis for the classification:

6. Does the vendor need to be contacted? ☐ Yes ☐ No
   Vendor Name:
   Person contacted: Date:
   Vendor's comments:

7. What subsequent testing is required because of this failure?

   Subsequent Lot No.

   No. of snubbers to be tested

8. What corrective action and recurrence controls are to be taken?

Evaluation performed by: ________________________________ ____________
Snubber Engineer/SE Designee Date

Attachment 4
(Page 1 of 1)

Supported System/Component Analysis for Inoperable Snubber

WO No. ____________ Unit ______ Snubber UNID No. ____________

Subgroup No. ________ PER No. ____________ Mfg./Size ________________

Serial No. __________ Rated Load __________ Exam No. ________

1. Describe the condition(s) (e.g., snubber would not meet activation acceptance criteria, was locked up, had excessive drag force, damaged hardware etc.)

2. Attach the SE Evaluation of the attached component:

3. Based on the results of the Engineering Evaluation, has the snubber failure mode adversely affected the supported system or component?
   ☐ Yes ☐ No

______________________________ __________
Snubber Engineer/SE Designee Date

Attachment 5
(Page 1 of 1)

Test Data for New, Replacement, or Rebuilt Snubber Using the STB-200 Test Bench

NOTE

This Data Sheet is to be used only to document test bench functional test data of new, replacement or rebuilt snubbers and shall be attached to the Work Order, as appropriate.

WO No. ______________ Unit ______ Snubber UNID No. ______________

Serial No. ______________ Size ______ Rated Load ________ Exam No. ______

Snubber Test Data: Record maximum acceptable drag force based on Section 6.0B.2 ______ Lbs.

As-Left Test results:

Peak Final Drag Forces(lbs): ______________ Tension ______________ Compression

The As-Left drag force of the snubber is within the allowable load based on Section 6.0B.2

______ Yes ______ No ________________________ ____________ (AC)

Performer Signature Date

Activation takes place in both tension and compression and is less than or equal 0.02 g's.

______ Yes ______ No ________________________ ____________ (AC)

Performer Signature Date

Snubber Stroked Full Length ______ Yes ______ No

Snubber meets acceptance criteria ______ Yes ______ No

________________________ ____________

Performer Signature Date

Review test data for acceptability. If the test results are unacceptable, do not install snubber in any piping system, component, or feature in the plant.

____

____

____

________________________ ____________

Snubber Engineer/SE Designee Date

Attachment 6
(Page 1 of 2)

Evaluation of Loose or Missing Attachment Fasteners, or of "As-Found" Stroke Setting Outside of Acceptable Range

This evaluation shall be performed when fasteners, used for attachment of snubber to component, and to snubber anchorage, are discovered loose or missing prior to the As-Found functional testing. This evaluation also shall be performed if the snubber "As-Found" setting is outside of the acceptable range specified on the design drawing.

WO No. ______________ Unit _____ Date Discovered ___________

Snubber UNID No. __________ Serial No. __________ Subgroup __________

Exam No. ___________ Size __________ Rated Load ________ Lbs.

1. Describe the discovered condition and, if possible, determine cause:

______________________________ ______________

Performer Initials Date

Attachment 6
(Page 2 of 2)

Evaluation of Loose or Missing Attachment Fasteners, or of "As-Found" Stroke Setting Outside of Acceptable Range

Items 2, 3, and 4 are to be completed by Site Engineering Civil.

2. Evaluate to determine whether the cause may be localized or generic. Use this evaluation to select and list other suspect snubbers for verification, as applicable.:

3. Describe the corrective action(s) and provide the As-Found test result.

4. Conclusion: Is the snubber operable? ______ YES ______ NO

   Justification:

If "No", notify the Shift Manager or Unit Supervisor immediately. Then complete or request a failure analysis using Attachment 3, and a supported component or system analysis on Attachment 4, as necessary.

Evaluated by: ______________________________ ____________
Site Engineering Civil Date

Tennessee Valley Authority
Browns Ferry Nuclear Plant, Unit 2

Relief Request No. 2-ISI-40, Snubbers Inspection and Testing

Relief Request No. 2-ISI-40, Reference F

Browns Ferry Nuclear Plant, Surveillance Instruction, 0-SI-4.6.H-2B,
"Functional Testing of Bergen-Paterson, Anchor/Darling or Fronek Hydraulic Snubbers"

Browns Ferry Nuclear Plant

Unit 0

Surveillance Instruction

0-SI-4.6.H-2B

Functional Testing of Bergen-Paterson, Anchor/Darling or Fronek Hydraulic Snubbers

Revision 0011

Quality Related

Level of Use: Continuous Use

Effective Date: 11-04-2010

Responsible Organization: DEC, Design Eng Civil

Prepared By: Channing Mitchell

Approved By: Eric J. Frevold

Current Revision Description

Pages Affected: All

Type of Change: REVISION   Tracking Number: 012

This procedure is being revised to provide additional clarification on the drag force acceptance criteria.

Table of Contents

Table of Contents (continued)

1.0 INTRODUCTION

1.1 Purpose

This Surveillance Instruction implements Technical Requirements Manual (TRM) TR 3.7.4, and provides direction for the functional testing of Bergen-Paterson, Anchor/Darling, or Fronek hydraulic snubbers, as given in the Snubber Program Procedure (0-TI-398), on all safety related systems, inside and outside of the drywell.

1.2 Scope

The snubbers within the scope of this instruction are either accessible (outside of the Drywell) or inaccessible (inside the Drywell) during reactor operation. The Bergen-Paterson, Anchor/Darling, or Fronek hydraulic snubbers belong to Subgroup 1.

The portions of Technical Requirements TR 3.7.4 pertaining to visual examination of snubbers are implemented by Surveillance Instructions 1-SI-4.6.H-1, 2-SI-4.6.H-1, and 3-SI-4.6.H-1.

This Surveillance Instruction (SI) provides the requirements and guidance to perform functional testing of Bergen-Paterson, Anchor/Darling or Fronek hydraulic snubbers addressed as HSSA-3, -10, -20, -30, ADH-10, -20, -30, -50, -70 and -130 for Units 1, 2, and 3 as follows:

- Removal and reinstallation of Bergen-Paterson, Anchor/Darling or Fronek hydraulic snubbers to facilitate testing is accomplished in accordance with MPI-0-000-SNB004 and recorded in Attachment 2.
- Provides the requirements for functional testing and service life monitoring of Bergen-Paterson, Anchor/Darling or Fronek hydraulic snubbers. This instruction covers subgroup 1 (see Appendix B for snubber subgroup information). To completely fulfill the snubber Technical Requirements Manual (TRM) functional testing requirements, Surveillance Instructions 0-SI-4.6.H-2A, 0-SI-4.6.H-2C, 0-SI-4.6.H-2E, and 0-SI-4.6.H-2F must also be performed as required per TSR 3.7.4.2.
- Provides a means for the control and documentation of all snubber surveillance activities provided in this Surveillance Instruction.
- This Surveillance Instruction shall be used to verify operability of hydraulic snubbers suspected inoperable during performance of the visual examination SI's.

1.3 Frequency/Conditions

A. This Surveillance Instruction shall be performed each refueling outage and portions of it may be performed to establish operability in accordance with 1-SI-4.6.H-1, 2-SI-4.6.H-1, and 3-SI-4.6.H-1, Visual Examination of Hydraulic and Mechanical Snubbers.

B. This instruction may be performed at any time for snubbers outside the drywell, but may only be performed at a time when the drywell may be entered for snubbers inside the drywell.

C. All safety related snubbers shall be operable during all modes of operation as described in the Technical Requirements Manual TR 3.7.4, if the system is required to be operable during that mode.

D. Snubbers located inside the drywell on reactor vessel attached piping shall be OPERABLE whenever fuel is in the reactor vessel. Snubbers on the Main Steam, HPCI, and RCIC piping, in the drywell, are exempt from the operability requirement when safety related, seismically qualified steam line plugs are installed in the reactor vessel. If the associated supported systems are inoperable, snubbers inside the drywell on the Recirculation System, on the RHR System, and on the RWCU System are exempt from the operability requirements provided safety-related, seismically qualified plugs are installed both in the reactor vessel nozzles of the Recirculation System supply piping to the Recirculation System pump and the discharge nozzles of the Reactor Jet Pumps, and the applicable RWCU RPV bottom head drain valve BFR-1 DRV-010-0505, BFN-2-DRV-010-0505, or BFN-3-DRV-010-0505 is closed.

E. Snubbers on safety related systems that have experienced unexpected potentially damaging transients shall be evaluated for the possibility of concealed damage and functionally tested, if applicable.

F. A snubber removed from an operable safety related system must be reinstalled or replaced within 72 hours of its removal or declare the supported component or system inoperable and follow the appropriate action statement for that system.

G. For an inoperable snubber(s), within 72 hours, replace or restore inoperable snubbers to an operable status and perform an engineering evaluation on the supported component or system, if the snubber does **NOT** meet the functional test acceptance criteria of TSR 3.7.4.2. Otherwise, declare the system inoperable and follow the required actions specified in the TRM.
The engineering evaluation is to determine if the component or system restrained by the snubber(s) was adversely affected by inoperability of the snubber(s) during the previous operating cycle and ensure that the restrained component or system remains capable of meeting its design function. The engineering evaluation(s) for supported component or system analysis are to be recorded on Attachment 4.

1.3 Frequency/Conditions (continued)

H. Alternately, for a snubber removed and **NOT** replaced within 72 hours, or an inoperable snubber **NOT** replaced or restored within 72 hours, operability of the supported system may be verified based on an engineering evaluation of the system functional capability with the removed or inoperable snubber.

I. Snubbers removed for maintenance or determined to be inoperable on a non-operable safety related system must be reinstalled or replaced, in accordance with MPI-0-000-SNB004, and tested in accordance with this instruction prior to declaring the system operable.

J. For all subgroups, when subsequent testing is required, it shall continue within the respective subgroup until no failure is found.

K. New, replaced or rebuilt snubber(s) shall meet the functional test acceptance criteria before their installation in the unit and must have been functionally tested "Satisfactory", within 12 months prior to their installation.

2.0 REFERENCES

A. Technical Requirements Manual, TR 3.7.4, Snubbers.

B. 1-SI-4.6.H-1, Surveillance Instruction Visual Examination of Hydraulic and Mechanical Snubbers.

C. 2-SI-4.6.H-1, Surveillance Instruction Visual Examination of Hydraulic and Mechanical Snubbers.

D. 3-SI-4.6.H-1, Surveillance Instruction Visual Examination of Hydraulic and Mechanical Snubbers.

E. MPI-0-000-SNB002, Hydraulic Shock and Sway Arrestor Bergen-Paterson, Anchor/Darling and Fronek Unit Disassembly and Reassembly

F. MPI-0-000-SNB004, Instructions for Removing and Installing Pacific Scientific Mechanical, Bergen-Paterson, Anchor/Darling, Fronek, Grinnell Hydraulic and Bergen-Paterson or Lisega Torus Dynamic Restraint Snubbers.

G. BFN-VTM-B209-0230, Vendor Technical Manual for Bergen-Paterson Hydraulic Shock and Sway Arrestors.

H. 0-TI-398, Snubber Program Procedure

I. SPP-3.1, Corrective Action Program

2.0 REFERENCES (continued)

J. SPP-8.1, Conduct of Testing.

K. CDQ0-999-2002-0772, Evaluation for Seal Service Life Extension for Bergen Paterson, Anchor/Darling or Fronek Hydraulic Snubbers.

3.0 PRECAUTIONS AND LIMITATIONS

None

4.0 PREREQUISITES

A. Six months prior to each refueling outage, the supply of Bergen-Paterson, Anchor/Darling or Fronek hydraulic snubbers in the Snubber Rebuild Facility shall be reviewed. A number of snubbers equal to the 10% sample population for the Subgroup selected for functional testing during the upcoming refueling shall be identified and available for installation. The rebuilt snubbers shall have the proper paperwork with them to comply with the requirements of the Section XI Repair and Replacement Program. This paperwork should include the purchase contract and Certificate of Compliance for any material requiring traceability.

5.0 SPECIAL TOOLS AND EQUIPMENT RECOMMENDED

None

6.0 ACCEPTANCE CRITERIA

A. Responses which fail to meet the following "As-Found" functional test acceptance criteria require immediate notification of the Shift Manager or Unit Supervisor at the time of failure.

B. The snubber functional test shall verify that:

NOTE
Activation, bleed, or drag force acceptance criteria may be other than that described in the Steps below, if approved by Site Engineering on Attachment 5.

1. "As-Found"

   a. *Corrected activation* occurs in both directions of travel at a piston velocity greater than or equal 1 inch/minute and less than or equal 30 inches/minute.

   b. Bleed takes place after activation of the snubber in both the tension and compression directions.

   c. Drag forces do **NOT** exceed 4.0 percent of the snubber's rated load for snubbers sizes 3 kip to 20 kip and 3.0 percent of the snubber's rated load for snubber sizes 30 kip or greater.

2. "As-Left"

   a. Corrected activation occurs in both directions of travel at a piston velocity greater than or equal 5 inches/minute and less than or equal 20 inches/minute.

   b. Corrected bleed takes place after activation of the snubber in both tension and compression and shall be within the ranges shown in Appendix C for each size of snubber.

   c. Drag forces do **NOT** exceed 2.0 percent of the snubber's rated load.

C. The stroke setting shall be within the limits shown on the design drawing. Otherwise, complete Attachment 6.

6.0 ACCEPTANCE CRITERIA (continued)

D. There shall be no loose or missing fasteners for attachment of the As-Found Bergen-Paterson, Anchor/Darling or Fronek hydraulic snubber(s) to the component or the anchorage. Otherwise, complete Attachment 6.

E. **NOT** meeting acceptance criteria for stroke setting, or loose or missing fasteners, does **NOT** require testing an additional lot equal to 10% of the subgroup of snubbers. Evaluation of snubber operability, corrective actions, and selection of other suspect snubbers for verification shall be as specified on Attachment 3 or Attachment 6, as applicable.

7.0 PROCEDURE STEPS

7.1 Training and Qualification of Performers

[1] A thorough briefing should be conducted on SI performance prior to starting.

[2] The cognizant individual or Snubber Engineer responsible for the performance of the Surveillance Instruction must be qualified as a test director.

[3] Appropriate General Employee Training (GET) (including respirator training) should be completed by test personnel prior to performing this SI.

[4] Training required for the testing of hydraulic snubbers shall meet the requirements of Task Number MMY 510.

7.2 Preparation of Test Data Package

[1] **EXCLUDE** the snubbers from the initial test lot (sample plan) which are scheduled for deletion, in accordance with approved Design Change Notices.

[2] **EXCLUDE** the snubbers until the next outage from the initial test lot (sample plan) which are to be added, in accordance with approved Design Change Notices.

[3] **SELECT** snubbers for retest which were placed in the same location as snubbers which failed during the previous outage, if the failure analysis showed that the failure was due to the location. However, these snubbers shall be tested in addition to the initial 10 percent test lot (sample plan).

[4] **DETERMINE** the initial test lot (sample plan) as follows:

- **SELECT** 10 percent of the snubbers from subgroup 1 (**SEE** Appendix B).
- In general, **SELECT** the snubbers with the most time from the previous test.
- Sample should be weighed to include more snubbers from severe service areas (i.e. inside the drywell).
- **SELECT** snubbers that have experienced severe transients.
- **SELECT** snubbers of various sizes.

[5] **REVIEW** the applicable hanger drawings to verify the location and any conditions that will require special preparation or equipment.

7.2 Preparation of Test Data Package (continued)

[6] **REQUEST** scaffold or similar devices to be built or available, as necessary.

[7] **RECORD** the date, time and other required information on Attachment 1, and prior to REMOVAL of a snubber per MPI-0-000-SNB004 for functional test, **RECORD** the "As-Found" Stroke Setting in Attachment 2.

7.3 "As-Found" Functional Test Using the STB-200 Test Bench

[1] **IF** the extension or one of the end attachments has been removed, **THEN**

INSTALL the appropriate end attachments located in the snubber test facility.

[2] **ENSURE** the test bench has been warmed up in accordance with Appendix D of this procedure.

NOTE
The following describes a suggested procedure for "Testing a Snubber" using the STB 200 Snubber Test Bench with the upgraded Windows Software Operations Manual.

[3] **Powering Up The Test System**

TURN ON the master power switch on the control console. Make sure that the computer, monitor, and printer are turned on. **TURN ON** the main breaker on the Hydraulic Power Unit (HPU) located at the end of the power unit. **ENSURE** that all emergency stop buttons are pulled out.

[4] **Starting The Software**

Once the computer has "Booted Up", the Windows Desktop will be displayed. **SELECT** the "STB 200" icon and double click on it, this will Start the Test program. The "LOG ON" prompt window will appear. **ENTER** your user name and password in either upper or lower case letters. All functions required by the system are available in the screen, or from one of the Pull Down Menus at the top of the screen.

[5] **Daily Calibration Check**

PERFORM the Daily Calibration Check using Appendix D and sign the daily calibration form. After Daily Calibration Check has been completed, and the Daily Calibration Report is "Satisfactory", proceed on testing a snubber.

[6] A surface contact pyrometer may be used to **OBTAIN** the surface temperature of the snubber, and **RECORD** the temperature correction from Appendix D for the surface temperature obtained, on Attachment 2 as appropriate.

7.3 "As-Found" Functional Test Using the STB-200 Test Bench (continued)

[7] **Testing a Snubber**

[7.1] **Pick the Snubber Type**
Using the Snubber Pull Down List in the User Supplied Information block, **SELECT** the Type Snubber to be tested.

[7.2] **Enter the Header Information**
FILL in the other information as indicated in the User Supplied Information block.

[7.3] **Running the Test**

[7.3.1] **Pick the Test**

CLICK on the Type of Test (i.e., “As-Found” or “As-Left”) desired.

[7.3.2] **Start the Test**

CLICK on the Start Test button. If this is the first test performed on the snubber, the following two windows will appear:

[7.3.3] **Tare weight Window**

This window allows the User to “zero out” any offset load that the load cell may be reading. This should be performed BEFORE installing the snubber in the test bench. **WAIT** for the “Raw Reading” to settle (as far as possible), and then **CLICK** “Adjust Load Cell”. The “Adjustment” will be updated, and the “Adjusted Reading” should now read close to zero (0) lb. The “Adjust Load Cell” button may be Clicked again if a new adjustment value is desired.
Once the readings are as desired, **CLICK** the “Continue” button. **ENSURE** the correct load cell is connected to the machine. **CHOOSE** the proper bushings and pins for the snubber being tested, then **INSTALL** the bushings in both clevis attachments on the machine.

7.3 "As-Found" Functional Test Using the STB-200 Test Bench (continued)

[7.3.4] **Stroke and Position Window**

INSTALL the snubber in the test bench, with the piston or operable end toward the drive piston of the machine if possible. **ADJUST** the backstop and/or use the Jog Speed Slider to adjust the bench and the driver cylinder to the desired pin to pin dimension. The jog slider adjusts the jog speed. The joystick on the test frame controls the actual motion of the driver. **INSTALL** the pins through the bushing and the snubber spherical bearings.

ONCE the snubber has been pinned for a test, the snubber's piston position (distance from fully retracted position) should be accurately measured (within 0.1 inch) and entered in the SNUBBER EXTENSION window.

If the test program calculates that it cannot fully extend or fully retract the snubber during drag testing, one or more of the text windows on the screen will be highlighted in red. If this happens, the backstop will have to be adjusted and the snubber extension recalculated. The program calculates whether it can fully test the snubber through its stroke range. It will display the two ends of stroke (minus a 1/2 inch safety zones), the calculated center position and the bottomed out position for the snubber.

Once the data has been successfully entered, **TIGHTEN** the lock nuts on the load cell threaded rod snug tight to prevent slippage during the test.

ENTER the snubber UNID number, WO number, system number, serial number, and the test equipment information on Attachment 2 as required, and **CLICK** on "Continue with Test" to continue the test.

[7.3.5] **If an Activation Test is Selected**

After all the above steps have been completed, and PRIOR to starting an "As-Found" Activation Test, the test program will initiate a routine to set and stabilize the hydraulic system pressure at a calculated level sufficient to achieve the requested test load. During this period, the setpoint and actual pressures are displayed, along with the output voltage, and a "count down" value. When the pressure is near the desired value, the countdown value will decrement towards zero. If the pressure fluctuates out of limits, the countdown will reset to six. Once the pressure is stable enough to let the countdown complete, the test will begin automatically.

7.3 "As-Found" Functional Test Using the STB-200 Test Bench (continued)

OBSERVE that the snubber activates in both directions, to establish operability of the snubber in the "As-Found" condition.

RECORD all necessary information on Attachment 2, as appropriate.

NOTE
Forcing a test may allow the machine to overstress the snubber during the test!

If the user wishes to force a test, clicking the "Force the Test" button will initiate the test regardless of pressure.

Clicking the "Abort the Test" button will cause the test cycle to abort without performing the test.

[7.3.6] **If Drag Test is Selected**

If a Drag Test (i.e., ID, AC, and FD test sequence for "As-Left", and, AC, FD test sequence for "As-Found" test) is selected, the test system will automatically begin the drag test. The system will determine the starting position of the snubber, and choose the initial test direction to move towards the farthest end of stroke. The drag speed will be automatically controlled to the target speed set earlier. This test is to VERIFY free travel of the piston rod through its full stroke. The Raw Test Data graphed in real time is reviewed to:

VERIFY that the drag force of the snubber sizes 3 kip to 20 kip does **NOT** exceed 4% of the snubber rated load and snubbers sizes 30 kip or greater does not exceed 3% of the snubber rated load for the "As Found" and or 2% of rated load for the "As Left functional test .

RECORD this information on Attachment 2, as appropriate.

[7.3.7] **Printing the Results**

After the test is complete, the calculations appropriate to that test are performed and the results are displayed on the screen. This allows the user to review and determine if the "As-Found" test results meet the "As-Left" acceptance criteria, and plot the test results:

7.3 "As-Found" Functional Test Using the STB-200 Test Bench (continued)

IF the results are within the "As-Left" acceptance range, **THEN**

CLICK on the "Print Test" button to open the standard Windows printer dialog box. **SELECT** the proper printer, and **CLICK** "OK" to start the printing.

ATTACH the Printed Results in Attachment 2, as part of the work package.

For Activation tests on acceleration limiting snubbers only, the calculated acceleration lines will be printed if they are displayed on the graph when printing is requested.

[7.3.8] **Saving the Test Results**

To save a test file to disk, **CLICK** the "Save Test" button. This saves the test results in the "test_data" directory. The file name of the saved test result is as follows:
Work_Order_number Serial_number Test_Date Test_Type.csv

Where:
Work_Order_number is the value entered in the work order number entry
Serial_number is the value entered in the serial number entry
Test_Date is the date when test was performed
Test_Type is **ID** for initial drag tests, **AC** for activation tests and **FD** for final drag tests.
Tests are saved as comma separated variable files and may be directly loaded into Excel or similar spreadsheet programs as desired.

[7.3.9] **Running Another Test**

CLICK on the Type of test to be performed. The results of the last test will be erased, and the graph will rescale for the test to be done.

REPEAT the procedure from Step 7.3[7.3.2]. to complete Running Another Test (i.e., the "As-Left"), as needed.

[7.3.10] **Testing Another Snubber**

SELECT a new snubber type, if necessary, from the snubber pull down list. If a snubber of the same type is to be tested, the user has to only change the serial number, hanger number, and work order entries.

7.3 "As-Found" Functional Test Using the STB-200 Test Bench (continued)

REPEAT this procedure from Step 7.3[7.3.1]. to **COMPLETE** Testing Another Snubber.

NOTE
Do NOT shutdown the console power without exiting Windows properly.

[7.4] **Quitting and Shutting Down the System**

TURN OFF the 480Vac power on the HPU. On the computer screen, **SELECT** EXIT from the File Menu. When the Windows screen appears, **CLICK** on START, then SHUTDOWN, and **CLICK** on **SHUT DOWN** the Computer. Then **CLICK** OK.
When the computer has completely shutdown, **TURN OFF** the main power switch on the current control consoles.

NOTE
At this time the machine has completed Running the Test. Unless you are leaving the building, leave the machine running so it will **NOT** have to be warmed up to perform another test (i.e., the "As-Left" test) as needed.

[8] **DETERMINE** if the "As-Found" test results meet the acceptance criteria in Section 6.0B.1.

[9] **ENTER** the information on Attachment 2, as appropriate.

[10] **IF** the test results are within the acceptable range of Section 6.0B1, **THEN**

COMPARE the "As-Found" test results with the "As-Left" acceptance criteria in Section 6.0B.2.

[11] **IF** the test results are within the "As-Left" acceptance criteria, **THEN**

PREPARE the snubber for reinstallation. **IF NOT, THEN**

PERFORM the "As-Left" testing in accordance with Section 7.4, as necessary, to obtain the acceptable "As-Left" range.

7.3 "As-Found" Functional Test Using the STB-200 Test Bench (continued)

[12] **IF** a snubber is determined to be inoperable, including case specific criteria, **THEN**

- **NOTIFY** the Shift Manager or Unit Supervisor immediately.
- **REQUEST** a failure analysis using Attachment 3, and a supported component or system analysis on Attachment 4, as necessary.
- **DETERMINE** the subsequent test lot (sample plan), as required.
- **SELECT** the number of snubbers equal to 10 percent of the remaining snubbers in that subgroup.
- In general, **SELECT** the snubbers with the most time from the previous test.
- **FILL OUT** the applicable sections of Attachment 2, as required.
- **ENSURE** test data package is ready for Shift Manager/Unit Supervisor authorization.
- **PERFORM** applicable functional test for the subsequent test lot (sample plan).

7.4 "As-Left" Functional Test Using the STB-200 Test Bench

[1] **DETERMINE** if the "As-Left" testing is required based on the following:

- **IF** the snubber has been rebuilt, **THEN**

  PERFORM the "As-Left" testing in accordance with this Section.

- **IF** the results of Step 7.3[10] DO **NOT** meet the acceptance criteria in Section 6.0B.2, **THEN**

  MAKE adjustments and **PERFORM** the "As-Left" test.

[2] If the test machine has been left on, it will be ready to Run Another Test. **CLICK** on the type of test (i.e., "As-Left") to be performed. The results of the last test will be erased, and the graph will rescale for the "As-Left" test to be done.

- **REPEAT** "Running the Test" procedure for the "As-Left" test starting from Step 7.3[7.3.2].

7.4 "As-Left" Functional Test Using the STB-200 Test Bench (continued)

[3] If the machine has been turned off, **THEN**

REPEAT the daily startup procedure, Appendix E and Steps 7.3[1] thru 7.3[7.2].

[4] **ENTER** the snubber number, WO number, system number, serial number and test equipment information on Attachment 2, as appropriate.

[5] **MEASURE** the snubber surface temperature with a pyrometer, and **RECORD** the temperature correction from Appendix D for the measured surface temperature reading on Attachment 2, as appropriate.

[6] **REPEAT** Steps 7.3[7.3] through 7.3[7.4] to complete the "As-Left" test. **NOTE** that the "As-Left" test sequence may start with the Initial Drag (ID) test, then the Activation (AC) test, and the Final Drag (FD) test. The "As-Found" test sequence may start with the Activation (AC) test, and then the Final Drag (FD) test.

[7] As shown in Appendix A, Illustrations A-1 and A-2, fluid from the rod end (extension or "out" direction) activates the poppet in the connector tube end of the valve block. Fluid from the blind end (compression or "in" direction) activates the poppet under the poppet stop and plug.

[8] If the snubber locks up at too low of a velocity, the width between the flats on the poppet head is too great, causing too much resistance to flow and the poppet closes at a low flow rate.

[9] **REPLACE** the poppet with one which has a smaller distance between the flats Appendix A, Table A-1.

NOTE

A change of approximately 0.006 inches (0.003 inches each side) in the distance between the flats will change the lock-up velocity approximately one inch per minute.

[10] If poppets are **NOT** available with the required dimensions, a small amount of material may be removed by filing/shaving or added by welding and then machined to the needed/finished dimension.

7.4 "As-Left" Functional Test Using the STB-200 Test Bench (continued)

NOTE

When enough material is to be removed that the squareness and symmetry is likely to be lost, the poppet heads are to be milled, removing the same amount of material from each side of the head.

[11] Material may be added to the poppet head which is too narrow, using weld procedure GE-11-0-1. After welding, the flats are to be milled to the proper dimension.

NOTES

1) Poppets supplied by Bergen-Paterson, manufactured after August 1977, are identified by an "E" stamped on the head of extension poppets. Compression poppets are **NOT** marked. Prior to August 1977, neither extension or compression poppets were marked. Appendix A, Table A-1 lists the current factory dimensions and part numbers for the poppets.
2) The valve and poppets used for the external pipe configuration snubbers do **NOT** have the exact dimensions as the later models, the current model poppets can be adjusted to give the required results in the external pipe configuration.
3) The bleed rate is determined by the amount of fluid that goes through the grooves in the tapered part of the poppet when it closes on the valve seat.
4) If the bleed rate is too fast for the amount of force developed, the grooves are too deep.

[12] **MACHINE** the tapered portion of the poppet at the existing angle just enough to almost clean off the grooves.

NOTE

A Noburod or Severance chamfering tool may be used to remove the grooves.

[13] **ENSURE** that the tapered portion of the poppet is machined smoothly and true, since it is a sealing surface.

7.4 "As-Left" Functional Test Using the STB-200 Test Bench (continued)

NOTE

If too much material is removed, the POPPET will be shortened and the spring will be compressed solid before the poppet reaches the seat.

[14] **RESTORE** the grooves, as necessary, using a machinist file.

NOTE

A slight change in the depth of the groove makes a lot of difference in the bleed rate of the snubber.

[15] Each time the valve, cylinder or accumulator are reassembled, **REFILL** them with silicone fluid and **BLEED/PURGE** any entrapped air from the passages of the snubber.

NOTE

Air contained in the fluid changes the lock-up and bleed rate, therefore the fluid should be free of air when the functional tests are performed.

[16] When the bleed rate has been adjusted or replacement poppets have been installed, the complete As-Left functional test is to be repeated.

[17] **REPEAT** Steps 7.3[7.3] through 7.3[7.4], as necessary, to achieve the lock-up and bleed rates, as required to meet the acceptance criteria stated in Section 6.0B.2.

[18] **RECORD** the "As-Left" test results on Attachment 2, and indicate " As-Left" test "Passed" on a tag to be wired to the snubber.

[19] The person responsible for performing the functional test shall **SIGN, DATE** the tag, and **ATTACH/WIRE** the tag to the snubber.

7.5 Hydraulic Snubber Service Life Monitoring

[1] **RECORD** the "As-Found" stroke setting in Attachment 2, as appropriate and **REMOVE** the snubber in accordance with MPI-0-000-SNB004.

[2] **PERFORM** "As-Found" test on the snubber, as required per Section 7.3.

[3] **REBUILD** the snubber replacing all seals and fluid in accordance with MPI-0-000-SNB002.

[4] **PERFORM** "As-Left" test for the snubber in accordance with Section 7.4.

[5] **REINSTALL** the snubbers in accordance with MPI-0-000-SNB004, and **RECORD** the "As-Left" Stroke Setting in Attachment 2, as appropriate.

[6] **PROVIDE** the Snubber Engineer with the following information:

A. Month and year the new seals were installed (actual service date)

B. Serial number

[7] Snubber Engineer is to **ADD** the service life (17 years) to the new service date and **ENTER** the month and year of the next required service in the appropriate data base.

[8] **SUBMIT** the completed original Attachment 2 to the Snubber Engineer/SE Designee for review and to include in the SI package.

7.6 Results Evaluation

> **NOTE**
>
> The following reviews are performed by the Snubber Engineer/SE-Designee, or a representative of Site Engineering Civil:

[1] **REVIEW** all of the test data on Attachment 2, as applicable.

[2] If any snubber is determined inoperable:

- **ENSURE** that the Shift Manager/Unit Supervisor has been notified of the inoperable snubber.
- **ENSURE** a PER has been initiated in accordance with SPP-8.1 and SPP-3.1.
- **INITIATE** a Work Order (WO) to replace the snubber, if necessary.
- **PERFORM** a failure evaluation of any inoperable snubber(s) and **DOCUMENT** on Attachment 3.
- **PERFORM** the supported system/component evaluation on Attachment 4.
- **SELECT** subsequent test lot, as required for functional test failure, or other snubbers for verification, as specified on Attachment 6.

7.7 Data Sheet Review

[1] **VERIFY** that all necessary attachments are included and all acceptance criteria have been met.

[2] **REVIEW** the completed SI package for final acceptance.

> **NOTE**
>
> Computer generated data sheets containing information regarding the initial test log, subsequent test logs, rebuilds, and etc., should be submitted with the SI data package.

[3] **SUBMIT** the completed package for closure.

8.0 ILLUSTRATIONS/ATTACHMENTS

Illustration 1 - Piston Rod Position Measurement

Appendix A - Snubber Flow Path, Control Valve Assembly, and Poppet Sizes

Appendix B - Subgrouping of Snubbers

Appendix C - Bergen-Paterson, Anchor/Darling and Fronek Hydraulic Snubber Acceptance Criteria

Appendix D - Correction for Temperature

Appendix E - Daily Startup Procedure for the STB-200 Test Bench

Appendix F - Common Modes of Snubber Failure and Possible Causes

Appendix G - Service Life Monitoring for Bergen-Paterson, Anchor/Darling and Fronek Hydraulic Snubbers

Attachment 1 - Surveillance Instruction Review Form

Attachment 2 - As-Found and As-Left Test Data, Removal and Reinstallation Data Sheets for Bergen Paterson Hydraulic Snubber

Attachment 3 - Engineering Failure Analysis for Inoperable Snubber

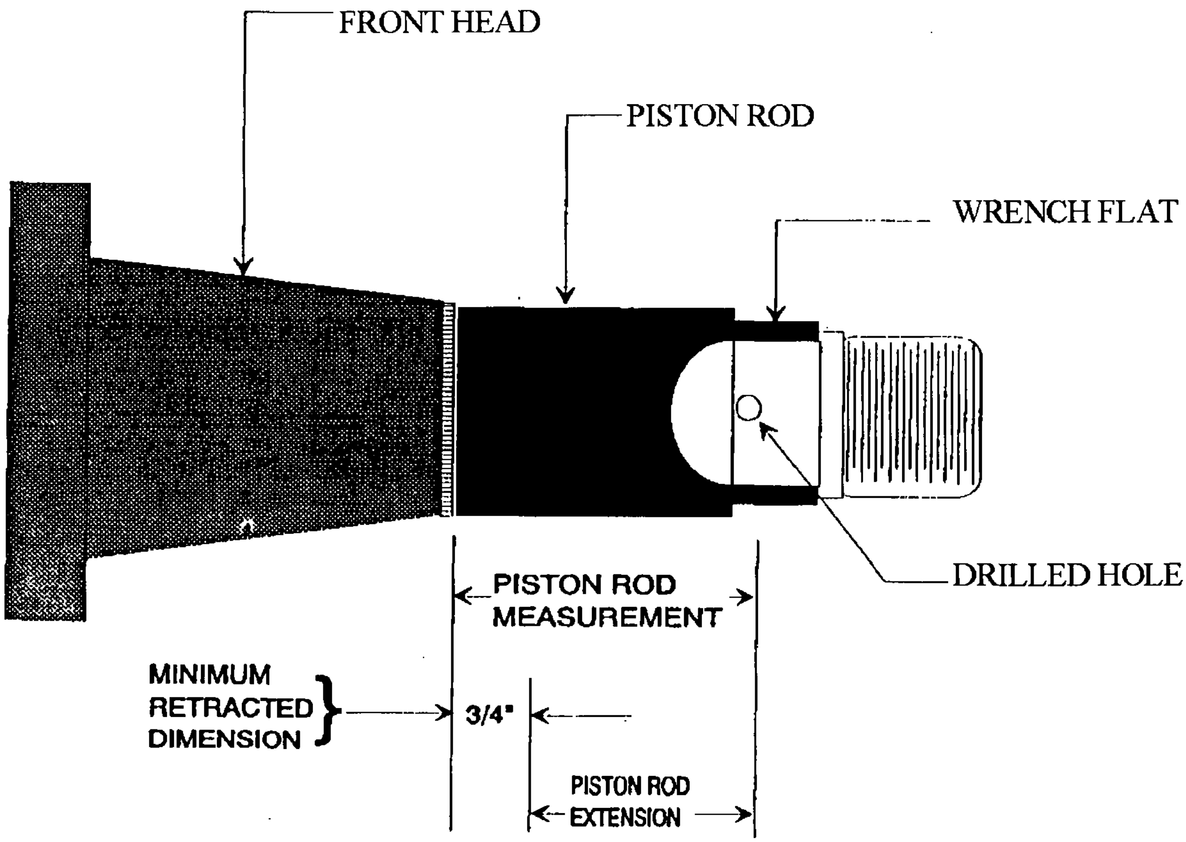
Attachment 4 - Supported System/Component Analysis for Inoperable Snubber

Attachment 5 - Functional Test Case Specific Acceptance Criteria

Attachment 6 - Evaluation of Loose or Missing Attachment Fasteners, or of "As-Found" Stroke Setting Outside of Acceptable Range

Illustration 1
(Page 1 of 1)

Piston Rod Position Measurement

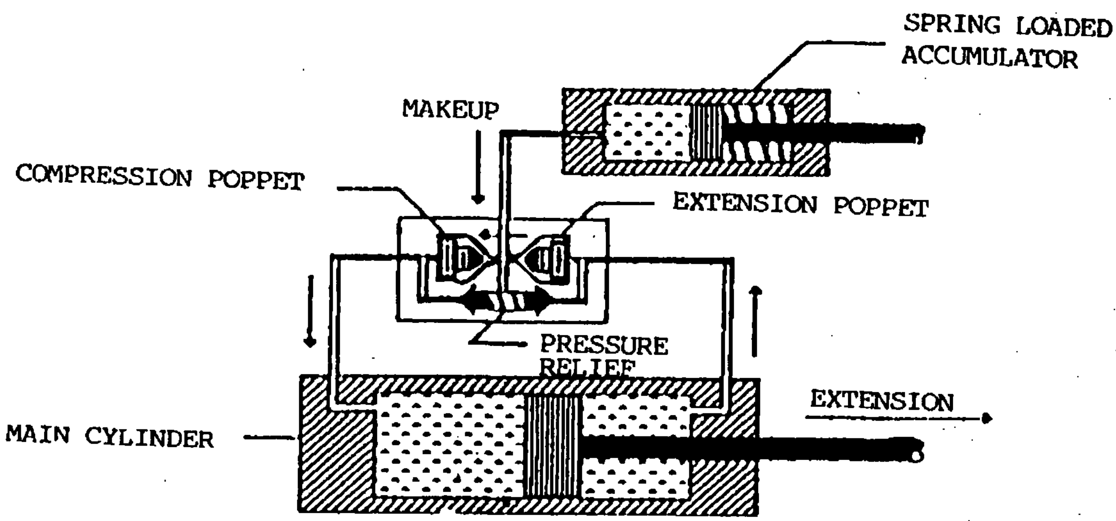


Appendix A
(Page 1 of 3)

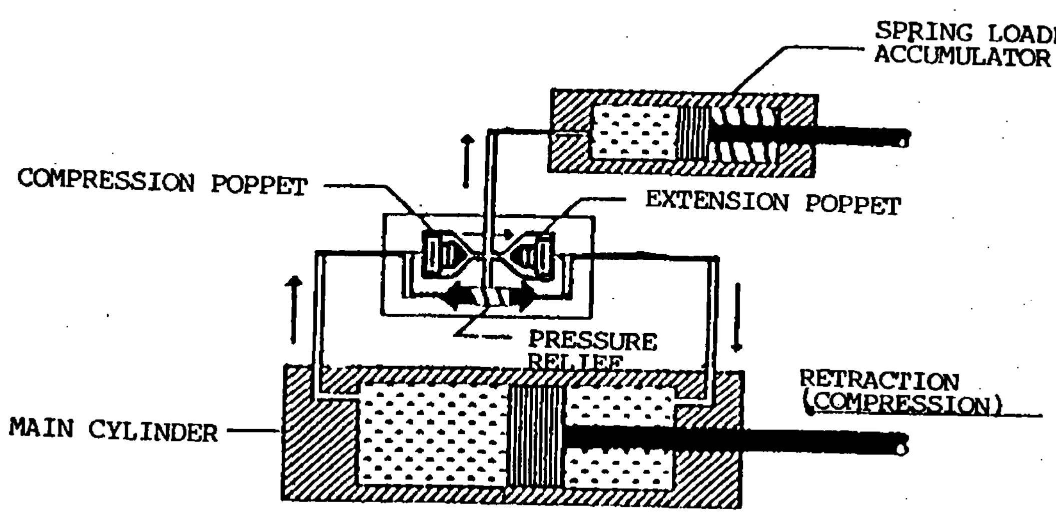
Snubber Flow Path, Control Valve Assembly, and Poppet Sizes

ILLUSTRATION A-1

BERGEN-PATERSON, ANCHOR/DARLING OR
FRONEK HYDRAULIC FLOW PATH



FLOW DURING EXTENSION



FLOW DURING RETRACTION

Appendix A
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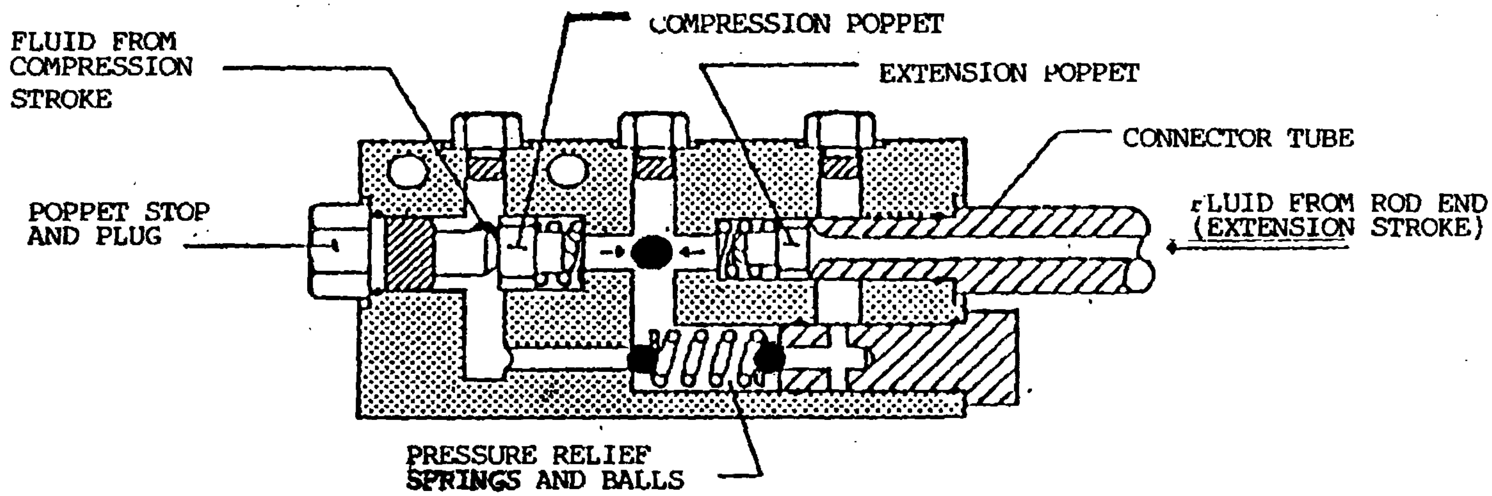
ILLUSTRATION A-2

CONTROL VALVE ASSEMBLY FOR MANIFOLD DESIGN



Appendix A
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TABLE A-1
STANDARD BERGEN-PATERSON, ANCHOR/DARLING AND FRONEK POPPETS

CYLINDER BORE	MODEL NUMBER	DIRECTION	BETWEEN FLATS *	NO. OF FLATS	PART NUMBER
1.5	HSSA-3	COMPRESSION	0.457"	2	202-1061-001
		EXTENSION	0.470"	2	202-1061-002
2.5	HSSA-10	COMPRESSION	0.415"	2	202-1061-003
		EXTENSION	0.435"	2	202-1061-004
3.25	HSSA-20	COMPRESSION	0.389"	2	202-1061-005
		EXTENSION	0.400"	2	202-1061-006
4.00	HSSA-30	COMPRESSION	0.389"	4	202-1061-007
		EXTENSION	0.410"	4	202-1061-008
5.00	HSSA-50	COMPRESSION	0.420"	4	202-1061-009
		EXTENSION	0.430"	4	202-1061-010
6.00	HSSA-70	COMPRESSION	0.375"	4	202-1061-011
		EXTENSION	0.410"	4	202-1061-012
8.00	HSSA-130	COMPRESSION	0.875"	4	202-1061-013
		EXTENSION	0.875"	4	202-1061-014

* Factory tolerance ± 0.0005"

Appendix B
(Page 1 of 1)

Subgrouping of Snubbers

1.0 SUBGROUPING:

For functional testing, the Bergen-Paterson, Anchor/Darling, or Fronek hydraulic snubbers, except 12 inch bore Torus dynamic restraints, belong to one subgroup as described below:

Subgroup 1 — All sizes of Bergen-Paterson (except the 12 inch bore Torus Dynamic Restraints), Anchor/Darling, and Fronek hydraulic snubbers.

When snubbers are added, deleted, or changed, based on modifications, they are added or deleted from their appropriate subgroups. If the added snubbers do **NOT** fit an existing subgroup, a revision to this SI describing the new subgroup or a revision to an existing subgroup is required.

Snubbers tested from severe service areas will remain a part of their respective subgroup, unless a failure analysis is performed and a separate subgroup is justified and incorporated into this SI.

Severe service areas include inside the drywell and in the main steam valve vault room.

There have been minimal failures of snubbers in these locations, therefore, testing 10 percent of the snubbers in these areas each refueling outage satisfies the intent of the surveillance requirement.

Appendix C
(Page 1 of 4)

Bergen-Paterson, Anchor/Darling and Fronek Hydraulic Snubber Acceptance Criteria

AS-FOUND	
SIZE	LOCKUP IN/MIN
HSSA-3	1-30
HSSA-10	1-30
HSSA-20	1-30
HSSA-30	1-30
ADH-20	1-30
ADH-30	1-30
ADH-50	1-30
ADH-70	1-30
ADH-130	1-30

AS-LEFT	
SIZE	LOCKUP IN/MIN
HSSA-3	5-20
HSSA-10	5-20
HSSA-20	5-20
HSSA-30	5-20
ADH-20	5-20
ADH-30	5-20
ADH-50	5-20
ADH-70	5-20
ADH-130	5-20

Appendix C
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Bergen-Paterson, Anchor/Darling and Fronek Hydraulic Snubber Acceptance Criteria

LOAD AND BLEED TABLE				
BERGEN-PATERSON 3				
		BLEED RATE		PERCENT
LOAD		MIN.	MAX.	LOAD
1000		0.6	4.95	33%
1500		1	7.5	50%
1800		1.2	9	60%
2000		1.34	10.05	67%
2400		1.6	12	80%
2500		1.66	12.45	83%
3000		2.0	15.0	100%
BERGEN-PATERSON 10				
		BLEED RATE		PERCENT
LOAD		MIN.	MAX.	LOAD
1000		0.2	1.5	10%
2000		0.4	3	20%
3000		0.6	4.5	30%
4000		0.8	6	40%
5000		1	7.5	50%
6000		1.2	9	60%
7000		1.4	10.5	70%
8000		1.6	12	80%
9000		1.8	13.5	90%
10000		2.0	15.0	100%
BERGEN-PATERSON, ANCHOR/DARLING (ADH), Fronek 20				
		BLEED RATE		PERCENT
LOAD		MIN.	MAX.	LOAD
5000		0.5	2.5	25%
10000		1	5	50%
12000		1.2	6	60%
15000		1.5	7.5	75%
16000		1.6	8	80%
20000		2.0	10.0	100%
BERGEN-PATERSON, ANCHOR/DARLING (ADH), Fronek 30				
		BLEED RATE		PERCENT
LOAD		MIN.	MAX.	LOAD
5000		0.33	1.67	17%
10000		0.66	3.34	33%
15000		1	5.01	50%
18000		1.2	6.01	60%
20000		1.33	6.68	67%
24000		1.59	8.02	80%
25000		1.66	8.35	83%
30000		2.0	10.0	100%

Appendix C
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Bergen-Paterson, Anchor/Darling and Fronek Hydraulic Snubber Acceptance Criteria

LOAD AND BLEED TABLE				
ANCHOR/DARLING (ADH), Fronek 50				
		BLEED RATE		PERCENT
LOAD		MIN.	MAX.	LOAD
5000		.2	.8	10%
10000		.4	1.6	20%
15000		.6	2.4	30%
20000		.8	3.2	40%
25000		1.0	4.0	50%
30000		1.2	4.8	60%
35000		1.4	5.6	70%
40000		1.6	6.4	80%
45000		1.8	7.2	90%
50000		2.0	8.0	100%
ANCHOR/DARLING (ADH), Fronek 70				
		BLEED RATE		PERCENT
LOAD		MIN.	MAX.	LOAD
7000		.2	.8	10%
14000		.4	1.6	20%
21000		.6	2.4	30%
28000		.8	3.2	40%
35000		1.0	4.0	50%
42000		1.2	4.8	60%
49000		1.4	5.6	70%
56000		1.6	6.4	80%
63000		1.8	7.2	90%
70000		2.0	8.0	100%
ANCHOR/DARLING (ADH), Fronek 130				
		BLEED RATE		PERCENT
LOAD		MIN.	MAX.	LOAD
13000		.2	.8	10%
26000		.4	1.6	20%
39000		.6	2.4	30%
52000		.8	3.2	40%
65000		1.0	4.0	50%
78000		1.2	4.8	60%
91000		1.4	5.6	70%
104000		1.6	6.4	80%
117000		1.8	7.2	90%
130000		2.0	8.0	100%

Appendix C
(Page 4 of 4)

Bergen-Paterson, Anchor/Darling and Fronek Hydraulic Snubber Acceptance Criteria

AS-FOUND	
SIZE	Drag
HSSA-3	4%
HSSA-10	4%
HSSA-20	4%
HSSA-30	3%
ADH-20	4%
ADH-30	3%
ADH-50	3%
ADH-70	3%
ADH-130	3%

AS-LEFT	
SIZE	Drag
HSSA-3	2%
HSSA-10	2%
HSSA-20	2%
HSSA-30	2%
ADH-20	2%
ADH-30	2%
ADH-50	2%
ADH-70	2%
ADH-130	2%

Appendix D
(Page 1 of 1)

Correction for Temperature

LOCKUP (ACTUATION)				BLEED (RELEASE)			
F	Correction	F	Correction	F	Correction	F	Correction
50	4	75	-1	50	1.00	75	-0.25
51	3.8	76	-1.2	51	0.95	76	-0.30
52	3.6	77	-1.4	52	0.90	77	-0.35
53	3.4	78	-1.6	53	0.85	78	-0.40
54	3.2	79	-1.8	54	0.80	79	-0.45
55	3	80	-2	55	0.75	80	-0.50
56	2.8	81	-2.2	56	0.70	81	-0.55
57	2.6	82	-2.4	57	0.65	82	-0.60
58	2.4	83	-2.6	58	0.60	83	-0.65
59	2.2	84	-2.8	59	0.55	84	-0.70
60	2	85	-3	60	0.50	85	-0.75
61	1.8	86	-3.2	61	0.45	86	-0.80
62	1.6	87	-3.4	62	0.40	87	-0.85
63	1.4	88	-3.6	63	0.35	88	-0.90
64	1.2	89	-3.8	64	0.30	89	-0.95
65	1	90	-4	65	0.25	90	-1.00
66	0.8	91	-4.2	66	0.20	91	-1.05
67	0.6	92	-4.4	67	0.15	92	-1.10
68	0.4	93	-4.6	68	0.10	93	-1.15
69	0.2	94	-4.8	69	0.05	94	-1.20
70	0	95	-5	70	0	95	-1.25
71	-0.2	96	-5.2	71	-0.05	96	-1.30
72	-0.4	97	-5.4	72	-0.10	97	-1.35
73	-0.6	98	-5.6	73	-0.15	98	-1.40
74	-0.8	99	-5.8	74	-0.20	99	-1.45
		100	-6			100	-1.50

NOTES

1) Correction Factor is 0.2 in/min/°F for snubber lockup (activation).
2) Correction Factor is 0.05 in/min/°F for snubber bleed (release).
3) These correction factors are for GE SF-1154 Silicone fluid.

Appendix E
(Page 1 of 3)

Daily Startup Procedure for the STB-200 Test Bench

1.0 DAILY STARTUP PROCEDURE

[1] **WARM-UP**

EXERCISE both benches (i.e., small and large) by selecting the Manual Control Panel function from the Tool Menu. **CLICK** on "Auto Exercise" in the Operating Mode block to engage the selected bench to automatically stroke back and forth. The system should be run this way until the oil temperature is above approximately 70°F or smooth operation is attained. Both test benches should be exercised. To change from one bench to the other, **CLICK** on the bench label.

[2] **CHECK THE PRESSURE TRANSMITTER**

NOTE

This instrument does NOT provide safety-related data. This check is optional.

In the Manual Control Panel mode, **SELECT** Manual in the Operating Mode block. **TURN** the "HP Pump" on, then use the HP Pump slider to increase the pressure command setting until the "Pressure" reading is approximately 2000 psi. **CHECK** the 0-3000 psi gauge in the front of the HPU. The two readings should be within ~ 200 psi.

[3] **PARK THE RAM**

SELECT the "Park the Ram" to prepare the bench for the Daily Calibration Check. This should be done for both benches.

[4] **SHUT DOWN THE MANUAL CONTROL PANEL**

CLICK on "Shut Down" to exit the Manual Control Panel.

Appendix E
(Page 2 of 3)

Daily Startup Procedure for the STB-200 Test Bench

2.0 STATUS CHECK

[1] During the warm-up period, the frame drive cylinders should be stroked using the proportional valve and/or the jog/drag valve.

[2] The system should be checked for loose fittings, bolts, etc.

[3] The filter indicators should be watched during cylinder stroking to insure that they are NOT illuminating.

[4] If the indicators are illuminating the filters should be changed before continuing with operation of the machine or any testing.

3.0 DAILY CALIBRATION CHECKS

The following calibration checks assure the functionality of the instrument and Data Acquisition and control System (DAS) for testing. They do not take the place of full system calibrations which must be performed on a periodic basis.

The instrument system (DAS system and transmitters) should be powered up for 30 minutes before any checks or testing is performed.

Prior to performing this function, both rams should have been "Parked" using the "Park the Ram" function in the Manual Control Panel.

[1] **SELECT THE DAILY CALIBRATION FUNCTION**

SELECT the Daily Calibration Check function from the "Tools" menu.

[2] **CONNECT THE LOW RANGE LOAD CELL AS DIRECTED**

If directed to by the software, electrically connect the Low Range Load Cell as instructed. The load cell does **NOT** need to be mechanically mounted in the test bench, but it must be connected to its electrical cable.

[3] **STORE THE "ZERO" CALIBRATION READINGS**

For each instrument click the "STORE" button in the "ZERO" column on the Daily Calibration screen for that instrument. The zero reading will be captured in the "Actual" "Zero" column. If it is within limits, the box will turn gray. If it is **NOT** within limits, the box will turn yellow.

Appendix E
(Page 3 of 3)

Daily Startup Procedure for the STB-200 Test Bench

3.0 DAILY CALIBRATION CHECKS (continued)

[4] **STORE THE "SPAN" CALIBRATION READINGS**

For each instrument, press in the "CAL" button on the front of the instrument, then **CLICK** the "STORE" button in the "SPAN" column on the Daily Calibration screen for that instrument. The span reading will be captured in the "ACTUAL" "SPAN" column. If it is within limits, the box will turn gray. If it is **NOT** within limits, the box will turn yellow.

[5] **PRINT THE REPORT**

When all readings for both benches have been stored, **CLICK** on the "PRINT" button to print the Daily Calibration Report. If the report is "SATISFACTORY", continue the testing. If the report is "UNSATISFACTORY", halt and correct the problem before continuing.

Appendix F
(Page 1 of 1)

Common Modes of Snubber Failure and Possible Causes

TYPE	COMMON MODES OF FAILURE	POSSIBLE CAUSE
HYDRAULIC	No Lockup	Wrong Size Poppet Wrong Size Poppet Spring Poppet Frozen or Blocked Open Excessively low or No Fluid Lockup Adjustment Set Improperly Damaged Piston Rod Seal Damaged "O" Ring
	High Lockup	Wrong Size Poppet Wrong Size Poppet Spring Lockup Velocity Adjustment Set Improperly Damaged "O" Ring
	Low Lockup	Broken Poppet Spring Poppet Frozen or Blocked Closed Lockup velocity Adjustment Set Improperly Foreign Objects in Fluid
	High Bleed	Defective or Damaged Poppet Defective or Damaged Poppet Seat Wrong Size Poppet Bleed Adjustment Set Improperly Damaged "O" Ring
	No Bleed	Foreign Objects in Fluid Bleed Adjustment Set Improperly
	Miscellaneous	Hardware Improper Installation Improper Handling or Abuse Misapplication Overload Vibration or Wear

Appendix G
(Page 1 of 1)

Service Life Monitoring for Bergen-Paterson, Anchor/Darling and Fronek Hydraulic Snubbers

The service life of snubbers may be extended based on an evaluation of the records of functional tests, maintenance history, and environment conditions to which the snubbers have been exposed.

Seal service life of hydraulic snubbers shall be monitored to ensure that the service life of the seals is **NOT** exceeded. The maximum expected service life for various seals, seal materials and applications shall be estimated, based on engineering information and seals shall be replaced so that the maximum expected seal service life does **NOT** expire during a period when the snubber(s) are required to be operable. Based on current seal manufacturer's data and operating experience, ethylene propylene seals are expected to have a maximum service life of approximately 10 years for the Bergen-Paterson, Anchor/Darling, or Fronek hydraulic snubbers. This maximum seal service life may be extended to 17.3 years based on the evaluation results documented in Ref. 2.0K.

The piston, piston rod, cylinder and glands are also subject to wear, especially in high vibration installations. Those, and other moving parts of the snubber, should be examined carefully each time the seals are replaced, and replacements made to prevent leakage or other conditions of loss of function before the next time the snubber is to be rebuilt.

To ensure that the seal service life does **NOT** expire and to distribute the work load between the refueling outages, replace the seals in approximately 10 percent of the Bergen-Paterson hydraulic snubbers each refueling outage. However, review the required seal service date on the data base and replace the seals whose required seal service date will occur before the next scheduled refueling outage, unless justification is provided for extending the service life of those seals. Seals replacement work shall be performed and documented in accordance with MPI-0-000-SNB002 or by a comparable vendor procedure. Seal service life monitoring data shall be recorded in an appropriate data base as determined by the Snubber Engineer/SE Designee.

Each time that the seal service life start and expiration dates change as a result of seals replacement the data base should be revised to incorporate current status of the seal service life.

Attachment 1
(Page 1 of 1)

Surveillance Instruction Review Form

REASON FOR TEST:

- ☐ Scheduled Surveillance
- ☐ System Inoperable (Explain in Remarks) UNIT MODE ____________
- ☐ Maintenance (See WO No. below)
- ☐ Other (Explain in Remarks)

W.O. NO. ________________ SNUBBER UNID ________________ SERIAL NO. ________________

PRE-TEST REMARKS: ____

____

____

PERFORMED BY:

Initials	Name (Print)	Name (Signature)

NOTE: The following entries for contacting Shift Manager/Unit Supervisor shall be marked N/A if the snubber is NOT Inoperable.

NOTIFY Shift Manager/Unit Supervisor when snubber found Inoperable. ________

SM/UNIT SUPERVISOR CONTACTED ________________ Date__________ Time ________

NOTIFY Shift Manager/Unit Supervisor when snubber Operability is restored. ________

SM/UNIT SUPERVISOR CONTACTED ________________ Date__________ Time ________

MECHANICAL MAINTENANCE REVIEWER ________________________ Date ________

Signature attests that I understand the scope and purpose of this instruction and that, to the best of my knowledge, it was properly performed in accordance with instruction in that: the recording, reduction, and evaluation of data is complete and correct; acceptance criteria is met or justification for exceptions is provided; portions of test performed were appropriate for specified test conditions or reasons for test; deficiencies were evaluated and dispositioned; reportability was evaluated; marginal results were evaluated with respect to potential for future problems based on operating experience and regulatory requirements; and instruction was complete except as noted in post-test remarks.

SNUBBER ENGINEER/SITE ENGINEERING CIVIL REVIEWER ________________________ Date__________

SCHEDULING COORDINATOR ________________________ Date ________

POST-TEST REMARKS: ____

____

____

Attachment 2
(Page 1 of 4)

As Found and As Left Test Data, Removal and Reinstallation Data Sheets for Bergen-Paterson, Anchor/Darling or Fronek Hydraulic Snubbers

AS-FOUND BERGEN-PATERSON, ANCHOR/DARLING OR FRONEK HYDRAULIC SNUBBER TEST DATA

W.O. No. ____________________ Date:

Snubber UNID: ____________________ Pyrometer Number: ____________________

Serial Number: ____________________ Calibration Due Date: ____________________

Exam Number: ____________________ (Cal. Accuracy ± 2°F)

Snubber Rated Load: ____________________

Temperature/Correction: ____________________

	Activation (in/min)	Temp Correction (in/min)	Corrected Activation (in/min)	Generic Acceptance Criteria *	Performer Signature/Date
Tension Compression	______ ______	______ ______	______ ______	1 in/min ≤ Corrected Activation ≤ 30 in/min	Signature__________ Date ________(AC)
	Bleed (in/min)	Temp Correction (in/min)	Corrected Bleed (in/min)		
Tension Compression	______ ______	N/A N/A	N/A N/A	Bleed takes place after snubber activation	Signature__________ Date ________(AC)
	Drag(lbs)				
Tension Compression	______ ______	N/A N/A	N/A N/A	Does not exceed % of snubber rated load (see pg 33) Rated Load x ____ = ____lbs	Signature__________ Date ________(AC)
					________/______ Initials / Date

* Case Specific Acceptance Criteria may be approved on Attachment 5.

Snubber meets Generic Acceptance Criteria: ____Yes ____No ________/______ Initials / Date

Snubber meets Case Specific Acceptance Criteria __Yes __No __N/A ________/______ Initials / Date

If neither the Generic nor the Case Specific acceptance criteria has been met, Notify the Shift Manager or Unit Supervisor immediately.

____________________________ __________
SNUBBER ENGINEER/SE DESIGNEE Date

Attachment 2
(Page 2 of 4)

AS-LEFT BERGEN-PATERSON, ANCHOR/DARLING OR FRONEK HYDRAULIC SNUBBER TEST DATA

W.O. No. ____________________ Date: __________

Pyrometer Number: __________

Snubber UNID: __________ Calibration Due Date: __________

Serial Number: __________ (Cal. Accuracy ± 2° F)

Exam Number: __________

Snubber Rated Load: __________

Temperature/Correction: __________

	Activation (in/min)	Temp Correction (in/min)	Corrected Activation (in/min)	Generic Acceptance Criteria *	Performer Signature/Date
Tension Compression	______ ______	______ ______	______ ______	5 in/min ≤ Corrected Activation ≤ 20 in/min	Signature__________ Date ________(AC)
	Bleed (in/min)	Temp Correction (in/min)	Corrected Bleed (in/min)		
Tension Compression	______ ______	______ ______	______ ______	Corrected bleed takes place after snubber activation and shall be within the range shown in App. C	Signature__________ Date ________(AC)
	Drag(lbs)				
Tension Max: Compression Max:	______ ______	N/A N/A	N/A N/A	Does not exceed 2% of snubber rated load Rated Load x 0.02 = ________LBS	Signature__________ Date ________(AC)
Copy of the plotted as-found test results is attached to this data sheet.					_______/______ Initials / Date

* Case Specific Acceptance Criteria may be approved on Attachment 5.

Snubber meets Generic Acceptance Criteria: ____Yes ____No _______/______ Initials / Date

______________________________ __________

SNUBBER ENGINEER/SE DESIGNEE Date

Attachment 2
(Page 3 of 4)

REMOVAL AND REINSTALLATION OF BERGEN-PATERSON, ANCHOR/DARLING OR FRONEK HYDRAULIC SNUBBER

W.O. No. ____________________ Unit ______ Snubber UNID No. ______________

Serial No. ____________ Subgroup __________ Test Lot: ___ Initial ___ Subsequent

Exam No. ___________ Size ________ Rated Load ________ lbs.

Design drawing number _____________

Shift Manager/Unit Supervisor and Snubber Engineer/SE Designee notified prior to removal of snubber for functional testing.

________________________________	__________	__________
Foreman/Designee	Date	Time

As-Found Stroke Setting_______

(Equals piston rod measurement minus 3/4”. Refer to ILLUSTRATION 1.)

Required Stroke Setting Range _______
(from Design drawing)

Pipe Temp.: ________°F, If other than ambient (per 0-47B435-5F, Note 24), notify Snubber Engineer/Site Engineering Civil.

Pyrometer No.: ________ Calibration Due Date: _____________

(Calibration Accuracy ± 2° F)

The As-Found Stroke Setting is within the acceptable limits shown in the design drawing listed above. If the answer is “No”, initiate Attachment 6.

_____ Yes _____ No ___________________________ __________(AC)

Performer Signature Date

All fasteners for the As-Found snubber are secured and acceptable (i.e., no loose or missing fasteners on the component anchorage).
If the answer to the above is “No”, intiate Attachment 6.

_____ Yes _____ No ___________________________ __________(AC)

Performer Signature Date

Attachment 2
(Page 4 of 4)

REMOVAL AND REINSTALLATION OF BERGEN-PATERSON, ANCHOR/DARLING OR FRONEK HYDRAULIC SNUBBERS

W.O. No. ____________________ Unit _______ Snubber UNID No. ________________

Snubber reinstallation:

Same snubber reinstalled	___ Yes	_ No	
If No, enter Bergen-Paterson, Anchor/Darling or Fronek serial number	Serial Number ________________		
Snubber is reinstalled in proper location	___ Yes	_ No	
Snubber is reinstalled with base of housing up (for vertical snubbers)	___ Yes	_ No	
All locking devices are secured	___ Yes	_ No	
Cotter pins are spread	___ Yes	_ No	____ N/A
Spherical bearing greased	___ Yes	_ No	____ N/A
Gaps between spacers and spherical bearing are 1/16 inch each side, 1/8 inch total or less	___ Yes	_ No	
Snubber is tagged	___ Yes	_ No	
Bolts and jam nuts torqued	___ Yes	_ No	____ N/A
Anti-seize compound applied, as needed	___ Yes	_ No	____ N/A
As-Left Stroke Setting ________________			

See Attachment 4 of MPI-0-000-SNB004 for Torque Wrench Documentation

________________________ Performer Signature ________ Date

The As-Left Stroke Setting is within the acceptable limits shown in the design drawing.

______ Yes ______ No ________________________ Performer Signature ________ Date

SHIFT MANAGER/UNIT SUPERVISOR notified of operable and reinstalled snubber.

________________________ Foreman/Designee (AC) ________ Date

Remarks: ____

____

Attachment 3
(Page 1 of 2)

Engineering Failure Analysis for Inoperable Snubber

WO No. ________________ Unit ______ Snubber UNID No. ______________

Subgroup No. _________ PER No. ______________ Mfg./Size ____________________

Serial No. ___________ Rated Load ___________ Exam No. ________ Lot _______

1. Describe the mode of failure, as discussed on Appendix F.

   ☐ Locked up ☐ High Drag Force ☐ Snubber would **NOT** activate
   ☐ Damage to snubber hardware ☐ Other

   Explain (if necessary)

2. Describe the conditions of the failure:

3. Determine the cause of failure, using Appendix F for the possible causes (disassembly of the snubber may be necessary):

4. For a snubber that does **NOT** activate, release, is locked up, or damaged hardware, was the cause of the failure a design or manufacturing defect?
   ☐ Yes ☐ No

   Explain Evaluation:

Attachment 3
(Page 2 of 2)

Engineering Failure Analysis for Inoperable Snubber

WO No. ________________ Unit _______ Snubber UNID No. ______________

Subgroup No. _________ PER No. ______________ Mfg./Size ____________________

Serial No. ___________ Rated Load ___________ Exam No. ________ Lot _______

5. Snubber failure classified as: ☐ Location ☐ Manufacturing ☐ Design ☐ Unknown
   ☐ Other
   Explain:

6. Does the vendor need to be contacted? ☐ Yes ☐ No
   Vendor Name:
   Person contacted:
   Date:
   Vendor's comments:

7. What subsequent testing is required because of this failure?

   Subsequent Lot No.

   No. of snubbers to be tested

8. What corrective action and recurrence controls are to be taken?

Evaluation performed by: ________________________________ ____________

Snubber Engineer/SE Designee   Date

Attachment 4
(Page 1 of 1)

Supported System/Component Analysis for Inoperable Snubber

WO No. ________________ Unit ______ Snubber UNID No. ______________

Subgroup No. _________ PER No. ______________ Mfg./Size ____________________

Serial No. ____________ Rated Load ___________ Exam No. ________

1. Describe the condition(s) (e.g., snubber would **NOT** activate, was locked up, or excessive drag force, damaged hardware etc.).

2. Attach the SE Evaluation of the attached component:

3. Based on the results of the Engineering Evaluation, has the snubber failure mode adversely affected the supported system or component?
☐ Yes ☐ No

________________________________ ____________
Snubber Engineer/SE Designee Date

Attachment 5
(Page 1 of 1)

Case Specific Acceptance Criteria

WO No. ____________ Unit ______ Snubber UNID No. ____________

Subgroup No. ________ PER No. ____________ Mfg./Size ________________

Serial No. __________ Rated Load __________ Exam No. ________

1. Record the parameter (i.e., activation, drag) and the test results that are outside the standard acceptance criteria:

2. Specify the Case Specific Acceptance Criteria and provide justification:

______________________________ ____________

Site Engineering Civil Date

Attachment 6
(Page 1 of 2)

Evaluation of Loose or Missing Attachment Fasteners or of "As-Found" Stroke Setting Outside of Acceptable Range

This evaluation shall be performed when fasteners, used for attachment of snubber to component, and to snubber anchorage, are discovered loose or missing prior to the As-Found functional testing. This evaluation also shall be performed if the snubber "As-Found" setting is outside of the acceptable range specified on the design drawing.

WO No. ________________ Unit _____ Date Discovered _____________

Snubber UNID No. ___________ Serial No. ____________ Subgroup __________

Exam No. _____________ Size __________ Rated Load ________ Lbs.

1. Describe the discovered condition and, if possible, determine cause:

_________________________________ _______________
Performer Initials Date

Attachment 6
(Page 2 of 2)

Evaluation of Loose or Missing Attachment Fasteners or of "As-Found" Stroke Setting Outside of Acceptable Range

Items 2, 3, and 4 are to be completed by Site Engineering Civil.

2. Evaluate to determine whether the cause may be localized or generic. Use this evaluation to select and list other suspect snubbers for verification, as applicable.

3. Describe the corrective action(s) and provide the As-Found test result.

4. Conclusion: Is the snubber operable? ______ YES ______ NO

   Justification:

   If "No", notify the Shift Manager or Unit Supervisor immediately. Then complete or request a failure analysis using Attachment 3, and a supported component or system analysis on Attachment 4, as necessary.

   Evaluated by: ______________________________ Date __________

Tennessee Valley Authority

Browns Ferry Nuclear Plant, Unit 2

Relief Request No. 2-ISI-40, Snubbers Inspection and Testing

Relief Request No. 2-ISI-40, Reference G

Browns Ferry Nuclear Plant, Surveillance Instruction, 0-SI-4.6.H-2C, "Functional Testing of Bergen-Paterson Torus Dynamic Restraints"

TVA

Browns Ferry Nuclear Plant

Unit 0

Surveillance Instruction

0-SI-4.6.H-2C

Functional Testing of Bergen-Paterson Torus Dynamic Restraints

Revision 0005

Quality Related

Level of Use: Continuous Use

Effective Date: 09-17-2010

Responsible Organization: DEC, Design Eng Civil

Prepared By: Channing Mitchell

Approved By: Eric J. Frevold

Current Revision Description

Pages Affected: Coversheet, revision description, and 29

Type of Change: Tracking Number: 006

This procedure is revised to remove torque M&TE sign off from Attachment 2 and refer to MPI-0-000-SNB004 for torque requirements for reinstallation of snubbers.

Table of Contents

Table of Contents (continued)

1.0 INTRODUCTION

1.1 Purpose

This Surveillance Instruction implements Technical Requirements Manual (TRM) TR 3.7.4, and provides direction for functional testing of Bergen-Paterson Torus Dynamic Restraints, as given in the Snubber Program Procedure (0-TI-398).

1.2 Scope

NOTES

For the purposes of this instruction, the snubbers are categorized into two major groups, based on whether the snubbers are accessible or inaccessible during reactor operation. These major groups may further be divided into subgroups based on design of the snubbers or may be established by engineering analysis based on environment or other failures which may be expected to affect the operability of the snubbers within the group.

The terms group or category may be used interchangeably throughout this instruction.

Visual verification of snubbers is implemented by Surveillance Instructions 2-SI-4.6.H-1, and 3-SI-4.6.H-1.

This Surveillance Instruction (SI) provides the requirements and guidance to perform functional testing of Bergen-Paterson Torus Dynamic Restraints, Type/Size BP-12 as follows:

- Removal and reinstallation of Bergen-Paterson Torus Dynamic Restraint snubbers to facilitate testing is accomplished in accordance with MPI-0-000-SNB004 and recorded in Attachment 2.
- Provides the requirements for functional testing and service life monitoring of Bergen-Paterson Torus Dynamic Restraint snubbers. This instruction covers subgroup 5 only (see Appendix A for snubber subgroup information). To completely fulfill the snubber Technical Requirements (TR) functional testing requirements, Surveillance Instructions 0-SI-4.6.H-2A, 0-SI-4.6.H-2B, 0-SI-4.6.H-2D, and 0-SI-4.6.H-2E must also be performed.
- Provides guidance in the operation of the snubber test equipment.
- Provides a means for the control and documentation of all snubber surveillance activities provided in this Surveillance Instruction.
- This Surveillance Instruction shall be used to verify operability of the Torus Dynamic Restraint snubbers suspected inoperable during performance of the visual inspection SIs.

1.3 Frequency/Conditions

A. This Surveillance Instruction shall be performed each refueling outage and portions of it may be performed to establish operability in accordance with 2-SI-4.6.H-1, 3-SI-4.6.H-1, Visual Examination of Hydraulic and Mechanical Snubbers.

B. All safety related snubbers shall be operable during all modes of operation as described in Technical Requirements Manual TR 3.7.4, if the system is required to be operable during that mode.

C. Snubbers on safety related systems that have experienced unexpected potentially damaging transients shall be evaluated for the possibility of concealed damage and functionally tested, if applicable.

D. A snubber removed from an operable safety related system must be reinstalled or replaced within 72 hours of its removal or declare the supported component or system inoperable and follow the appropriate action statement for that system.

E. For inoperable snubber(s), within 72 hours, replace or restore inoperable snubbers to an operable status and perform an engineering evaluation on the supported component or system, if the snubber does **NOT** meet the functional test acceptance criteria of TSR 3.7.4.2. Otherwise, declare the system inoperable and follow the required actions specified in the TRM. The engineering evaluation is to determine if component or system restrained by the snubber(s) was adversely affected by inoperability of the snubber(s) during the previous operating cycle and ensure that the restrained component or system remains capable of meeting its design function. The engineering evaluation(s) for supported component or system analysis are to be recorded on Attachment 4.

F. Snubbers removed for maintenance or determined to be inoperable on a non-operable safety related system must be reinstalled or replaced, in accordance with MPI-0-000-SNB004 and tested in accordance with this instruction, prior to declaring the system operable.

G. For all subgroups, when subsequent testing is required, it shall continue within the respective subgroup until no failure is found, or all snubbers in that subgroup have been tested, or all suspect snubbers identified by the failure analysis have been tested, as applicable. The failure analysis shall be used, as applicable, in selecting snubbers to be tested in the subsequent lot in an effort to determine the OPERABILITY of other snubbers that may also be subject to the same failure mode.

H. New, replaced, or rebuilt snubber(s) shall meet the functional test acceptance criteria before their installation in the unit and must have been functionally tested “Satisfactory”, within 12 months prior to their installation.

2.0 REFERENCES

A. Technical Requirements Manual TR 3.7.4, Snubbers.

B. 2-SI-4.6.H-1, Surveillance Instruction Visual Examination of Hydraulic and Mechanical Snubbers.

C. 3-SI-4.6.H-1, Surveillance Instruction Visual Examination of Hydraulic and Mechanical Snubbers.

D. MPI-0-000-SNB004, Instructions for Removing and Reinstalling Pacific Scientific Mechanical, Bergen-Paterson, Anchor/Darling, Fronek, Grinnell Hydraulic and Bergen-Paterson or Lisega Torus Dynamic Restraint Snubbers.

E. BFN-VTM-B209-0160, Vendor Technical Manual for Bergen-Paterson Reactor Torus Ring Hydraulic Shock Suppressors.

F. PE-8997-P1, Special 4 inch Tapered Pin Installation and Removal Procedure.

G. 0-TI-398, Snubber Program Procedure

H. SPP-3.1, Corrective Action Program

I. SPP-6.4, Measuring and Test Equipment

J. SPP-8.1, Conduct of Testing

3.0 PRECAUTIONS AND LIMITATIONS

None

4.0 PREREQUISITES

The Technical Contract Manager (TCM) or Snubber Engineer shall ensure the following have been complied with, for contractor M&TE used on site, prior to the beginning of any work.

4.0 PREREQUISITES (continued)

[1] **ENSURE** SPP-6.4 has been referenced in the appropriate Work Order (WO) package(s), and necessary steps have been added to the functional testing contract to ensure all requirements of SPP-6.4 have been complied with.

[2] **INFORM** all contractors or vendors, using M&TE onsite, of the requirements of SPP-6.4 before performance of M&TE related activities, particularly, concerning non-conforming M&TE.

[3] The contractor or vendor personnel performing SR/QR activities shall provide documentation that the M&TE has a certified calibration from an Approved Suppliers List (ASL) listed calibration facility.

[4] After use, documentation of post-use calibration is provided within 90 days of the departure of the M&TE from the site.

[5] Six months prior to each refueling outage, ensure a minimum of two(2) of the new Lisega Torus Dynamic Restraint snubbers have been tested and are ready for installation, if required. No paperwork is required, since these snubbers are **NOT** under the Section XI Repair and Replacement Program.

5.0 SPECIAL TOOLS AND EQUIPMENT RECOMMENDED

	DESCRIPTION	SIZE	QUANTITY
A.	Rigging-Slings, Hoists, etc.	As required	As required
B.	SF-1154 Silicone Fluid		As required
C.	Porta-Power	Compact	1
D.	Strap Wrench	As required	As required
E.	Snubber Test Machine	As required	1
F.	Positioning Fixture	(BP P/N 78044)	1
G.	Hand Spanner Wrench	(BP P/N 78031)	1
H.	Lifting Fixture	(BP P/N 78048)	1
I.	Jam Nut Torquing Fixture	(BP P/N 78022)	1

6.0 ACCEPTANCE CRITERIA

A. Responses which fail to meet the As-Found Acceptance Criteria require immediate notification of the Snubber Engineer/SE designee at the time of failure.

6.1 "As-Found"

A. Activation shall occur in both directions of travel at a piston velocity greater than or equal 6 inches/minute and less than or equal 25 inches/minute.

NOTE
For As-Found testing the only requirement for the bleed rate is that there is bleed after the snubber activates.

B. Bleed shall take place after activation of the snubber, in both tension and compression.

C. Drag forces shall be less than or equal to 15,000 pounds.

D. Activation, bleed, or drag force acceptance criteria may be other than that described in the steps above, if approved by Site Engineering on Attachment 5.

6.2 "As-Left"

A. Activation shall occur in both directions of travel at a piston velocity greater than or equal 6 inches/minute and less than or equal 25 inches/minute.

B. Bleed shall take place after activation of the snubber, in both tension and compression and be greater than or equal 1 inch/minute and less than or equal 10 inches/minute.

C. Drag force shall be less than or equal to 15,000 pounds.

D. Activation, bleed, or drag force acceptance criteria may be other than that described in the steps above, if approved by Site Engineering on Attachment 5.

E. There shall be no loose or missing fasteners for attachment of the "As-Found" dynamic restraint(s) to the component or the anchorage. Otherwise, complete Attachment 6.

F. The stroke setting shall be within the limits shown on the design drawing.

7.0 PROCEDURE STEPS

7.1 Training and Qualification of Performers

A. Thorough briefing should be conducted on SI performance prior to starting.

B. The cognizant individual or Snubber Engineer responsible for the performance of the Surveillance Instruction must be qualified as a test director and a Technical Contract Manager (TCM) since this work is performed by a contractor.

C. Appropriate General Employee Training (GET) should be received by contractor personnel prior to performing this SI.

D. Contractor must provide the TCM or Snubber Engineer a set of qualification certificates prior to beginning any work. The TCM shall place certifications in the Work Orders for the functional test being performed.

7.2 Preparation of Test Data Package

[1] **SELECT** snubbers for retest which were placed in the same location as snubbers which failed during the previous outage, if the failure analysis showed that the failure was due to the location. However, these snubbers shall be tested in addition to the initial 10 percent test lot (sample plan).

[2] **DETERMINE** the initial test lot (sample plan) as follows:

- **SELECT** 10 percent of the snubbers from subgroup 5 (see Appendix A).
- **SELECT** the snubbers with the most time from the previous test.
- **SELECT** snubber(s) that must be tested per an engineering evaluation, if applicable.
- **SELECT** snubbers that have experienced severe transients.
- **SELECT** snubbers that leak the most hydraulic fluid.
- **FILL OUT** the applicable section(s) of Attachment 2, as required.

[3] **REVIEW** the applicable support drawings to verify the location and any conditions that will require special preparation or equipment.

[4] **REQUEST** scaffold or similar devices to be built or available, as necessary.

[5] **ENSURE** Prerequisites concerning Contractor used M&TE have been complied with prior to any work being performed.

7.3 "As-Found" Functional Testing of Bergen-Paterson Torus Dynamic Restraints

NOTES

1) When performing the "As-Found" functional test per this instruction, do **NOT** add fluid, bleed, stroke, or perform any adjustments or maintenance prior to testing. Insofar as possible, the test should be strictly "As-Found" and record the results on Attachment 2.
2) Ensure the test machine has been connected and perform test in accordance with Appendix C.

[1] **ENTER** the required snubber information on Attachment 2.

[2] The Bergen-Paterson Torus Dynamic Restraints may be tested by an in-place test machine, such as the Enertech TESTAN II, API/BARKER In- Place Snubber Test Machine or equal.

[3] After the completion of the test, **OBSERVE** that the restraint's corrected lockup is between 6 and 25 inches per minute (inclusive) and bleeds after lockup for establishing operability of the snubber in the "As-Found" condition, as given in Section 6.1.

[4] **RECORD** all necessary information on Attachment 2.

[5] **VERIFY** that the drag force of the restraint is less than or equal to 15,000 pounds.

[6] **ENTER** this information on Attachment 2.

[7] **DETERMINE** if the "As-Found" test results meet the acceptance criteria in Section 6.1.

[8] **COMPARE** the "As-Found" test results of the restraint with the "As-Left" range given in Section 6.2. If the test results are within the acceptable range for the "As-Left" criteria, **PREPARE** the restraint for reinstallation. If **NOT**, **REPLACE** the snubber with a Lisega large bore snubber.

7.3 "As-Found" Functional Testing of Bergen-Paterson Torus Dynamic Restraints (continued)

[9] If a snubber fails to meet the functional test acceptance criteria, **PERFORM** the following:

- **NOTIFY** the Snubber Engineer/SE Designee immediately for determination of further actions.
- **REQUEST** a Case Specific Acceptance Criteria evaluation using Attachment 5.
- **REQUEST** a failure analysis on Attachment 3 and a supported component or system analysis on Attachment 4, as necessary.

NOTE
A subsequent test lot (sample plan) equal to 10 percent of the remaining restraints in the subgroup shall be functionally tested for each failed restraint. The subsequent test will include only restraints within the subgroup, unless the failure analysis indicates that the failure may be generic to snubbers in other subgroups.

[10] **DETERMINE** the subsequent test lot (sample plan), as required.

[11] Select 10% of the remaining snubbers from subgroup 5, based on selection Criteria from Section 7.2[2].

[12] **ENSURE** test data package is ready for Shift Manager/Unit Supervisor authorization.

[13] **PERFORM** Sections 7.3 and 7.4 for subsequent test lot (sample plan).

7.4 "As-Left" Testing of Bergen-Paterson Torus Dynamic Restraints

NOTES

1) The "As-Left" test must meet the acceptance criteria of Section 6.2.
2) If applicable ensure the test machine has been connected and perform test in accordance with Appendix C.

[1] If the results of Step 7.3[8] fall within the acceptance criteria for activation velocity and bleed rate range, reinstall snubber per MPI-0-000-SNB004.

[2] **ENTER** the snubber number, WO number, system number, serial number, and test equipment information on Attachment 2.

[3] Using the Enerpac cylinder or the in-place test machine, **STROKE** the snubber in both directions slowly and **REPEAT** stroking several times to refill the snubber and purge trapped air.

[4] **RECORD** the "As-Left" test results on Attachment 2.

7.5 Results Evaluation

NOTE

The following reviews are performed by the Snubber Engineer/SE Designee or a representative of Site Engineering (CIVIL).

[1] **COMPARE** the As-Found or As-Left test results on Attachment 2 to the acceptance criteria given in Section 6.1 or 6.2. If the As-Found or As-Left test results exceed the allowable for activation, bleed, and drag force, perform a case specific evaluation on Attachment 5, as necessary.

[2] **REVIEW** all of the test data on Attachment 2.

[3] If any snubber is determined to **NOT** meet the As-Found acceptance criteria:

- **NOTIFY** the Shift Manager/Unit Supervisor of the inoperable snubber.
- **INITIATE** a PER in accordance with SPP-8.1 and SPP-3.1.
- **INITIATE** a WO to replace the snubber with a Lisega large bore snubber.
- **PERFORM** the supported system/component evaluation on Attachment 4.
- **PERFORM** a failure evaluation of any inoperable snubber and **DOCUMENT** on Attachment 3.
- **SELECT** the subsequent test lot (sample plan).

7.6 Data Sheet Review

[1] **VERIFY** the WO to remove and reinstall the snubber has been initiated, as necessary and **ENTER** the WO number in the remarks section of Attachment 2.

[2] **VERIFY** that all applicable Attachments are completed for the snubber(s) tested.

[3] **VERIFY** the failure analysis of any failed snubber has been performed in accordance with Attachment 3 (disassembly may be necessary).

[4] **REVIEW** the Site Engineering (Civil) evaluation of the supported component or system analysis Attachment 4, if applicable.

[5] **VERIFY** the Case Specific Acceptance Criteria, Attachment 5, has been prepared, as applicable.

[6] **VERIFY** the Snubber Engineer/SE Designee has reviewed all of the attachments and all acceptance criteria have been met.

[7] **VERIFY** Contractor has provided the Snubber Engineer/SE Designee with appropriate documentation of all M&TE used on site.

[8] **REVIEW** the completed SI package for final acceptance.

[9] Prior to WO closure, **VERIFY** a copy of the pre-use and post-use calibration documentation are in the WO package.

NOTE
Computer generated data sheets containing information regarding the initial test log, subsequent test logs, rebuild, etc., shall be submitted with the SI data package.

[10] **SUBMIT** the completed package for closure.

8.0 APPENDIX/ATTACHMENTS

Appendix A	-	Subgrouping and Service Life Monitoring of Snubbers
Appendix B	-	Common Modes of Snubber Failure and Possible Causes
Appendix C	-	Wyle Laboratories procedure for In-Place Hydraulic Snubber Testing Using the API Test System
Attachment 1	-	Surveillance Instruction Review Form
Attachment 2	-	As-Found and As-Left Test Data, Removal and Reinstallation Data Sheets for Bergen Torus Dynamic Restraints
Attachment 3	-	Engineering Failure Analysis for Inoperable Snubbers
Attachment 4	-	Supported System/Component Analysis for Inoperable Snubbers
Attachment 5	-	Case Specific Acceptance Criteria
Attachment 6	-	Evaluation of Loose or Missing Attachment Fasteners

Appendix A
(Page 1 of 1)

Subgrouping and Service Life Monitoring of Snubbers

1.0 SUBGROUPINGS

A. For functional testing, the snubbers are divided into one subgroup as described below:

1. Subgroup 5 Bergen-Paterson 12 inch bore and Lisega Torus dynamic restraint hydraulic snubbers. For functional testing of Lisega snubbers, see 0-SI-4.6.H-2E.

2. When snubbers are added, deleted, or changed, based on modifications, they are added or deleted from their appropriate subgroups. If the added snubbers do **NOT** fit an existing subgroup, a revision to this SI describing the new subgroup or a revision to an existing subgroup is required. Table A-1 of this SI must be revised when the subgroups change.

3. There have been no failures of snubbers in these locations at this time; therefore, testing 10 percent of the snubbers in these areas each refueling outage satisfies the intent of the surveillance requirement.

TABLE A-1
SUBGROUPING OF SNUBBERS

Category Number	Subgroup Number (1)	Description	Quantity	
			Unit 2	Unit 3
7*	5 (BP 12 only)	Hydraulic Bergen-Paterson (Torus, 12" bore)	9	12

* This category is accessible at any time during power operation for the purpose of functional testing.

1. The subgroup listed is based on the design features and according to the manufacturer.

Total Bergen-Paterson Torus Dynamic Restraints in Unit 2 and 3 = 21.

Appendix B
(Page 1 of 1)

Common Modes of Snubber Failure and Possible Causes

TYPE	COMMON MODES OF FAILURE	POSSIBLE CAUSE
HYDRAULIC	No Lockup	Wrong size poppet. Wrong size poppet spring. Poppet frozen or blocked open. Excessively low or no fluid. Lockup adjustment set improperly. Damaged piston rod seal. Damaged O-ring.
	High Lockup	Wrong size poppet. Wrong size poppet spring lockup velocity. Adjustment set improperly. Damaged O-ring.
	Low Lockup	Broken poppet spring. Poppet frozen or blocked closed. Lockup velocity. Adjustment set improperly. Foreign objects in fluid.
	High Bleed	Defective or damaged poppet. Defective or damage poppet seat. Wrong size poppet. Bleed adjustment set improperly. Damaged O-ring.
	No Bleed	Foreign objects in fluid. Bleed adjustment set improperly.
	Miscellaneous	Hardware. Improper installation. Improper handling or abuse. Misapplication. Overload. Vibration or wear.

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Wyle Laboratories Procedure for In-Place Hydraulic Snubber Testing Using the API Test System

1.0 PURPOSE

The purpose of this procedure is to define the methods by which hydraulic snubbers may be subjected to performance tests using the Asmundson-Potter, Inc. (API) In-Place Test System.

2.0 SCOPE

This procedure applies to functional testing to determine the operability of hydraulic snubbers which are generally classified as large bore hydraulic snubbers.

3.0 DESCRIPTION

Hydraulic snubbers are designed to meet two basic requirements. First, they permit essentially resistance-free thermal displacements of pipe and other equipment. Second the snubber acts as a high stiffness member if the pipe or other equipment experiences a sudden high velocity such as that during a seismic occurrence. By design, when the snubber is subjected to a seismic occurrence, the snubber "locks up" or is "activated", thus limiting the velocity to a predetermined level. After "lock up", the snubber continues to "bleed" under a maintained load. Functional examination tests to be performed and acceptance criteria for each will be specified by the client, to determine the operability of the components being tested.

4.0 REFERENCES

A. API In-Place Test System Operating and Maintenance Manual

B. Wyle Laboratories' Safety Procedures

C. Customer's Purchase Order, Job Order, or contract

D. Customers Test Specification and Acceptance Criteria

Appendix C
(Page 2 of 6)

Wyle Laboratories Procedure for In-Place Hydraulic Snubber Testing Using the API Test System

5.0 PREREQUISITES

A. Prior to commencing functional test activities, the Wyle Site Supervisor or his designee will verify that the following have been completed:

1. A Job Order or equivalent work authorization document has been issued.
2. The Q.A./Q.C. Department has been notified of the testing schedule.
3. Appropriate documentation has identified snubbers to be tested.
4. All measurements and tests shall be performed at existing ambient conditions.
5. All instrumentation, measuring, and test equipment used in the performance of the test procedure shall be calibrated in accordance with Wyle Laboratories' Quality Assurance Program and reviewed by Browns Ferry M&TE Group, prior to use.
6. All test deficiencies shall be reported in accordance with Browns Ferry procedure SPP-8.1, with any non-conforming results being processed in accordance with Browns Ferry procedure SPP-3.1.

6.0 PRECAUTIONS

A. Observe safe radiological work practices.

7.0 TEST REQUIREMENTS

A. The test specimens shall be subjected to the following functional tests, as required. Test sequence may be varied as required to satisfy specific test situations. Test results shall be recorded on Attachment 2.

1. All acceptance criteria are listed in Section 6.0 of the procedure.

Appendix C
(Page 3 of 6)

Wyle Laboratories Procedure for In-Place Hydraulic Snubber Testing Using the API Test System

8.0 TEST INSTRUCTIONS

8.1 Pre-Test SET-UP

The test machine requires a 440/480, 3-phase, 30amp power source. Switch the computer, data acquisition and instrumentation electronics to their "on" positions, and respond to all computer prompts to perform a system "self-test". Following a 30 minute warm-up, perform the prefill procedure to purge all hoses. Connect all hydraulic hoses properly and verify that all connectors are secure. Verify that you have flow, using the pre fill procedure and continue for 30 seconds. This setup is required at the beginning of each day.

A calibration check may be performed prior to starting testing and after testing is complete, to verify accuracy of the system.

8.2 Snubber Unpinning Requirements

Unpin the snubber in accordance with MPI-0-000-SNB004.

8.3 Connections

The test machine shall be prepared and connected to access ports on both the tension and compression sides of the hydraulic cylinder within the high pressure boundaries of the snubber to be tested.

To do so, isolate the snubber's fluid reservoir, then remove the test access port plugs from the access ports and install quick disconnect fittings with adapters, as required. Take care to prevent contamination of snubber fluid and internals. Measure and record the pin-to-pin dimension of the snubber. Remove either or both snubber pins from their structural disconnect. Lift or lower the unpinned end of the snubber such that the full stroke of the snubber can be achieved without interference with existing structures. If movement is restricted with 1 pin, remove snubber per MPI-0-000-SNB004 for testing.

8.4 Visual Observation

The test specimen shall be visually observed during all testing for anomalous conditions, such as, fluid leakage, erratic motion, binding, and low fluid level. Retest is allowed if any data is in question.

Appendix C
(Page 4 of 6)

Wyle Laboratories Procedure for In-Place Hydraulic Snubber Testing Using the API Test System

8.5 Drag/Binding Force

The hydraulic hoses from the instrumentation box shall be connected to the snubber's access ports and the snubber pressurized to allow it to be stroked at an approximately constant low velocity (lower than lockup) and observed for binding. The specimen shall be fully stroked in tension and compression and the drag or binding forces recorded.

8.6 Lockup Velocity Test

Once it has been verified that the piston has reached the end of its stroke, flow shall be increased at a constant rate until lockup occurs. Lockup velocities in both tension and compression shall be recorded. Lockup is defined as the velocity at which the snubber's control valve activates, allowing the snubber to perform its restraining function.

8.7 Bleed Velocity Test

Following lockup, the pressure shall be increased to the equivalent of the snubber's full rated load (or other specified load) for the bleed rate test. Bleed velocity in both tension and compression shall be recorded. Bleed rate is defined as the snubber velocity that occurs after lockup under maintained load.

8.8 Post-Test Requirements

Upon completion of testing, if snubber installation is required, hoist or lower the snubber into position and if both ends have been unpinned, install one pin. Using the API test machine, "jog" or position the piston until the piston rod eye pinhole is aligned with the structural clevis pinhole and install the second snubber pin.

Remove connecting hoses and quick disconnects. Ensure that snubber ports are completely filled with hydraulic fluid. Reinstall the test access port plugs and torque per drawing requirements.

Ensure snubber reservoir fluid is at the proper level.

Appendix C
(Page 5 of 6)

Wyle Laboratories Procedure for In-Place Hydraulic Snubber Testing Using the API Test System

9.0 DOCUMENTATION

9.1 WYLE Testing

All of the testing will be performed by Wyle and documented on their forms, but the final results will be documented on Attachment 2 of this procedure.

9.2 Test Log

A test Log shall be maintained to provide a daily description of the testing performed and other significant information regarding specimen status **NOT** otherwise recorded.

9.3 Hydraulic Snubber Control Cards/Individual Snubber Data Sheet.

Test information, Notice of Anomaly (NOA) numbers (if required), test results, and pertinent information shall be recorded on the Hydraulic Snubber Control Card or in the format as required by the customer.

9.4 Test Documentation

A. The functional testing of snubbers will be complete when the documentation for each snubber is complete and the snubber is released for disposition.

B. The Wyle Site Supervisor or his designee will verify that the test prerequisites, test data, and the test results are complete. The Test Log shall reflect the work status.

9.5 Preliminary Test Results

Preliminary test results of the work performed at a customer's site may be communicated either verbally or in writing utilizing copies of the `Hydraulic Snubber Control Cards and Computer Data Sheets.

Appendix C
(Page 6 of 6)

Wyle Laboratories Procedure for In-Place Hydraulic Snubber Testing Using the API Test System

9.6 Certification Test Report

Final test results shall be presented in a Certification Test Report, in accordance with contract terms and conditions. This report shall consist of:

Inspections, observations, and work performed.

Instrumentation Equipment Sheet(s)

Notices of Anomaly (if applicable)

Certificates of Conformance (if required by the Purchase Order).

Attachment 1
(Page 1 of 1)

Surveillance Instruction Review Form

REASON FOR TEST:

☐ Scheduled Surveillance
☐ System Inoperable (Explain in Remarks)
☐ Maintenance (WO# ____________)
☐ Other (Explain in Remarks)

PLANT MODE 1 2 3 4 5(CIRCLE APPROPRIATE MODE)
MODE 1-POWER OPERATION
MODE 2-STARTUP
MODE 3-HOT SHUTDOWN
MODE 4-COLD SHUTDOWN
MODE 5-REFUELING

WO NO. ________________ SNUBBER UNID No. ________________ SERIAL NO. ________________

PRE-TEST REMARKS: ____________________________________

____

PERFORMED BY:

Initials	Name (Print)	Name (Signature)

NOTE: The following entries for contacting Shift Manager/Unit Supervisor shall be marked N/A if the snubber is NOT Inoperable.

NOTIFY Shift Manager/Unit Supervisor when snubber found Inoperable. __________ (Initial)

SM/UNIT SUPERVISOR CONTACTED ______________ Date__________ Time __________

NOTIFY Shift Manager/Unit Supervisor when snubber Operability is restored. __________ (Initial)

SM/UNIT SUPERVISOR CONTACTED ______________ Date__________ Time __________

MECHANICAL MAINTENANCE REVIEWER ______________________ Date __________

Signature attests that I understand the scope and purpose of this instruction and that, to the best of my knowledge, it was properly performed in accordance with instruction in that: the recording, reduction, and evaluation of data is complete and correct; acceptance criteria is met or justification for exceptions is provided; portions of test performed were appropriate for specified test conditions or reasons for test; deficiencies were evaluated and dispositioned; reportability was evaluated; marginal results were evaluated with respect to potential for future problems based on operating experience and regulatory requirements; and instruction was complete except as noted in post-test remarks.

SNUBBER ENGINEER/SITE CIVIL ENGINEERING REVIEWER ______________________ Date__________

SCHEDULING COORDINATOR ______________________ Date __________

POST-TEST REMARKS: ____________________________________

____

____

Attachment 2
(Page 1 of 4)

As-Found and As-Left Test Data, Removal and Reinstallation Data Sheets for Bergen Torus Dynamic Restraints

AS-FOUND TORUS DYNAMIC RESTRAINT TEST DATA

Work Order Number: ____________ Date: ____________

System Number: ____________ Exam Number: ____________

Snubber UNID Number: ____________ Snubber Rated Load: ____________

Serial Number: ____________

	Activation (in/min)	Acceptance Criteria	Performer Signature/ Date
Tension Compression	________ ________	6 in/min ≤ Activation ≤ 25 in/min	Signature ____________ Date ________(AC)
	Bleed (in/min)		
Tension Compression	________ ________	Bleed takes place after snubber activation	Signature ____________ Date ________(AC)
	Load(lbs)		
Tension		None	Signature ____________
Compression			Date ____________
	Drag(lbs)		
Tension Max: Avg: Compression Max: Avg:	 ________ ________ ________ ________	MAXIMUM 15,000 POUNDS	Signature ____________ Date ________(AC)
Copy of the plotted As-Found test results is attached to this data sheet.			______/_____ INITIALS DATE

* Case specific Acceptance Criteria may be approved on Attachment 5.

Snubber meets As-Found test acceptance criteria: ____Yes ____No

If the answer to the above is "No", Notify the Snubber Engineer/SE Designee immediately.

______________________________ ____________
SNUBBER ENGINEER/SE DESIGNEE Date

Attachment 2
(Page 2 of 4)

AS-LEFT TORUS DYNAMIC RESTRAINT TEST DATA

Work Order Number: ________________ Date: ____________

System Number: ____________________ Exam Number: __________________

Snubber UNID Number: ______________ Snubber Rated Load: ______________

Serial Number: ____________________

	Activation (in/min)	Acceptance Criteria	Performer Signature/ Date
Tension Compression	________ ________	6 in/min ≤ Activation ≤ 25 in/min	Signature ______________ Date _________(AC)
	Bleed (in/min)		
Tension Compression	________ ________	Bleed takes place after snubber activation and shall be within the range 1 in/min to 10 in/min	Signature ______________ Date _________(AC)
	Load(lbs)		
Tension		None	Signature ______________ Date ____________
Compression			
	Drag(lbs)		
Tension Max: Avg: Compression Max: Avg:	 ________ ________ ________ ________	MAXIMUM 15,000 POUNDS	Signature ______________ Date _________(AC)
Copy of the plotted As-Left test results is attached to this data sheet.			______/_____ INITIALS DATE

* Case specific Acceptance Criteria may be approved on Attachment 5.

Snubber meets As-Left test acceptance criteria: ____Yes ____No

If the answer to the above is "No", Notify the Snubber Engineer/SE Designee immediately.

SNUBBER ENGINEER/SE DESIGNEE ______________ Date ________

Attachment 2
(Page 3 of 4)

REMOVAL AND REINSTALLATION OF BERGEN PATERSON TORUS DYNAMIC RESTRAINTS

WO No. ____________________ Unit ______ Snubber UNID No. ________________

Serial No. ____________ Subgroup __________ Test Lot: Initial ___ Subsequent ___

Exam No. ___________ Size ________ Rated Load _______ lbs.

Design drawing number _____________

Shift Manager/Unit Supervisor and Snubber Engineer/SE Designee notified prior to removal of snubber for functional testing.

_________________________________ __________ __________
Foreman/Designee Date Time

As-Found Stroke Setting_______

Required Stroke Setting_______
(from Design drawing)

The As-Found Stroke Setting is within the acceptable limits shown in the design drawing listed above.

_____ Yes ______ No ____________________________ __________(AC)
Performer Signature Date

All fasteners for the As-Found snubber are secured and acceptable (i.e., no loose or missing fasteners on the component anchorage).

If the answer is “No”, complete Attachment 6.

_____ Yes ______ No ____________________________ __________(AC)
Performer Signature Date

Review test data for acceptability. If the test results are unacceptable, specify the action to be taken:
____
____
____

_________________________________ __________
SNUBBER ENGINEER/SE DESIGNEE Date

Attachment 2
(Page 4 of 4)

WO No. ____________ Unit ______ Snubber UNID No. ____________

Snubber reinstallation:

Same snubber reinstalled	___ Yes	___ No	
If No, enter Lisega TDR serial number	________	Serial Number (Lisega TDR)	
Snubber is reinstalled in proper location	___ Yes	___ No	
Snubber is reinstalled with base of housing up	___ Yes	___ No	
All locking devices are secured	___ Yes	___ No	
Cotter pins are spread	___ Yes	___ No	___ N/A
Spherical bearing greased	___ Yes	___ No	___ N/A
Gaps between spacers and spherical bearing are 1/16 inch each side, 1/8 inch total or less	___ Yes	___ No	
Snubber is tagged	___ Yes	___ No	
Bolts and jam nuts torqued	___ Yes	___ No	___ N/A
Anti-seize compound applied, as needed	___ Yes	___ No	___ N/A

As-Left Stroke Setting ____________

See Attachment 4 of MPI-0-000-SNB004 for Torque Wrench Documentation

____________________ Performer Signature ________ Date

The As-Left Stroke Setting is within the acceptable limits shown in the design drawing.

______ Yes ______ No ____________________ Performer Signature ________ Date

SHIFT MANAGER/UNIT SUPERVISOR notified of operable and reinstalled snubber.

____________________ Foreman/Designee ________ Date

Remarks: ____

____

____

Attachment 3
(Page 1 of 2)

Engineering Failure Analysis for Inoperable Snubbers

WO No. ________________ Unit __________ Snubber UNID No. ________________

Subgroup No. ___________ PER No. _____________ Mfg./Size _______________

Serial No. ______________ Rated Load __________ Exam No. ________ Lot______

1. Describe the mode of failure as discussed on Appendix B.
   ☐ Locked up ☐ High Drag Force
   ☐ Snubber would not activate ☐ Damage to snubber hardware

   Explain (if necessary)

2. Describe the conditions of the failure:

3. Determine the cause of the failure, using Appendix B for the possible causes (disassembly of the snubber may be necessary):

4. For a snubber that does not activate, release or locked up, was the cause of the failure a design or manufacturing defect? ☐ Yes ☐ No

   Explain evaluation:

5. Snubber Failure classified as: ☐ Location ☐ Manufacturing ☐ Design ☐ Unknown ☐ Other
   Explain:

Attachment 3
(Page 2 of 2)

Engineering Failure Analysis for Inoperable Snubbers

WO No. ________________ Unit __________ Snubber UNID No. ________________

Subgroup No. ___________ PER No. _____________ Mfg./Size ________________

Serial No. ______________ Rated Load __________ Exam No. ________ Lot______

6. Does the vendor need to be contacted? ☐ Yes ☐ No
   Vendor Name:
   Person contacted: Date: Vendor's comments:

7. What subsequent testing is required because of this failure?

   Subsequent Lot No. No. of snubbers to be tested

8. What corrective action and recurrence controls are to be taken?

Evaluation performed by: ______________________________ Date __________
Snubber Engineer/SE Designee

Attachment 4
(Page 1 of 1)

Supported System/Component Analysis for Inoperable Snubbers

WO No. ________________ Unit __________ Snubber UNID No. ________________

Subgroup No. ___________ PER No. _____________ Mfg./Size _______________

Serial No. _____________ Rated Load __________ Exam No. _______________

1. Describe the condition(s) (e.g., snubber would not activate, was the snubber locked up, or had excessive drag force, etc.).

2. Attach the SE evaluation of the attached component:

3. Based on the results of the Engineering evaluation, has the snubber failure mode adversely affected the supported system or component?

Snubber Engineer/SE Designee ___________________________ Date ___________

Attachment 5
(Page 1 of 1)

Case Specific Acceptance Criteria

WO No. ________________ Unit __________ Snubber UNID No. ________________

Subgroup No. ___________ PER No. _____________ Mfg./Size _______________

Serial No. ______________ Rated Load __________ Exam No. _______________

1. Describe the standard acceptance criteria:

   ☐ As-Found ☐ As-Left

2. Record the parameter (i.e., actuation, bleed, drag) and the test results that are outside the standard acceptance criteria:

   ☐ As-Found ☐ As-Left

3. Specify the case specific Acceptance Criteria and provide justification.

Site Engineering Civil ______________________________ Date ___________

Attachment 6
(Page 1 of 1)

Evaluation of Loose or Missing Attachment Fasteners

This evaluation shall be performed only when fasteners, used for attachment of snubber to component, and to snubber anchorage, are discovered loose or missing prior to the As-Found functional testing.

WO No. __________ Unit _____ Date Discovered ___________

Snubber UNID No. __________ Serial No. ________ Subgroup _________

Exam No. _______ Size _______ Rated Load _______Lbs. Pipe Size _______

1. Describe the discovered condition(s) and if possible, determine cause:

2. Evaluate to determine whether the cause may be localized or generic. Use this evaluation to select and list other suspect snubbers for verifying attachment fasteners, as applicable.:

Evaluated by: ______________________________ Date ___________

3. Describe the corrective action(s) and provide the As-Found test result.

Evaluated by: ______________________________ Date ___________

4. Conclusion: Is the snubber operable?

Justification:

Evaluated by: ______________________________ Date ___________

Tennessee Valley Authority
Browns Ferry Nuclear Plant, Unit 2

Relief Request No. 2-ISI-40, Snubbers Inspection and Testing

Relief Request No. 2-ISI-40, Reference H

Browns Ferry Nuclear Plant, Surveillance Instruction, 0-SI-4.6.H-2E,
"Functional Testing of Lisega Large Bore Torus Dynamic Restraint Snubbers"

Browns Ferry Nuclear Plant

Unit 0

Surveillance Instruction

0-SI-4.6.H-2E

Functional Testing of Lisega Large Bore Torus Dynamic Restraint Snubbers

Revision 0008

Quality Related

Level of Use: Continuous Use

Effective Date: 09-17-2010

Responsible Organization: DEC, Design Eng Civil

Prepared By: Channing Mitchell

Approved By: Eric J. Frevold

Current Revision Description

Pages Affected: Cover sheet, revision log, 6, and 43

Type of Change: REVISION Tracking Number: 010

This procedure is being revised to incorporate the following changes:

Section 1.3D incorporate the change made to Technical Requirements Manual TRM 3.7.4 "Snubbers", which addresses snubber operability with the installation of qualified plugs in the Recirculation Piping System.

Attachment 2 removed torque M&TE sign off and added statement to refer to MPI-0-000-SNB004 for torque requirements for reinstallation of snubbers.

Table of Contents

Table of Contents (continued)

1.0 INTRODUCTION

1.1 Purpose

This Surveillance Instruction implements Technical Requirements Manual (TRM) TR 3.7.4, and provides direction for the functional testing, of Lisega Large Bore Torus Dynamic Restraints, as given in the Snubber Program Procedure (0-TI-398), on safety related systems outside of the drywell.

1.2 Scope

The snubbers within the scope of this instruction are accessible during reactor operation. The Lisega Large Bore Torus Dynamic Restraints belong to Subgroup 5.

The portions of Technical Requirements TR 3.7.4 pertaining to the visual examination of snubbers are implemented by Surveillance Instructions 1-SI-4.6.H-1, 2-SI-4.6.H-1 and 3-SI-4.6.H-1.

This Surveillance Instruction (SI) provides the requirements and guidance to perform functional testing of Lisega Torus Dynamic Restraints for Units 1, 2 and 3, as follows:

- Removal and reinstallation of Lisega Torus Dynamic Restraints is accomplished per MPI-0-000-SNB004 and recorded in Attachment 2.
- Provides the requirements for functional testing and service life monitoring of Lisega Torus Dynamic Restraints. This instruction covers subgroup 5 only (see Appendix A for snubber subgroup information). To completely fulfill the snubber Technical Requirements (TR) functional testing requirements, Surveillance Instructions 0-SI-4.6.H-2A, 0-SI-4.6.H-2B, 0-SI-4.6.H-2C and 0-SI-4.6.H-2F must be performed as required per TSR 3.7.4.2.
- Provides a means for the control and documentation of all Lisega Torus Dynamic Restraint snubber surveillance activities provided in this Surveillance Instruction.
- This Surveillance Instruction shall be used to verify operability of Lisega Torus Dynamic Restraint snubbers suspected inoperable during performance of the visual examination SIs.

1.3 Frequency/Conditions

A. This Surveillance Instruction shall be performed each refueling outage and portions of it may be performed to establish operability in accordance with 1-SI-4.6.H-1, 2-SI-4.6.H-1, and 3-SI-4.6.H-1 Visual Examination of Hydraulic and Mechanical Snubbers.

B. This instruction may only be performed during an outage for the Lisega Large Bore Torus Dynamic Restraints.

C. All safety related snubbers shall be operable during all modes of operation as described in the Technical Requirements Manual TR 3.7.4, if the system is required to be operable during that mode.

D. Snubbers located inside the drywell on reactor vessel attached piping shall be OPERABLE whenever fuel is in the reactor vessel. Snubbers on the Main Steam, HPCI, and RCIC piping, in the drywell, are exempt from the operability requirement when safety related, seismically qualified steam line plugs are installed in the reactor vessel. If the associated supported systems are inoperable, snubbers inside the drywell on the Recirculation System, on the RHR System, and on the RWCU System are exempt from the operability requirements provided safety-related, seismically qualified plugs are installed both in the reactor vessel nozzles of the Recirculation System Loop supply piping to the Recirculation System pump and the discharge nozzles of the Reactor Jet Pumps, and the applicable RWCU RPV bottom head drain valve BFR-1 DRV-010-0505, BFN-2-DRV-010-0505, or BFN-3-DRV-010-0505 is closed.

E. Snubbers on safety related systems that have experienced unexpected potentially damaging transients shall be evaluated for the possibility of concealed damage and functionally tested, if applicable.

F. A snubber removed from an operable safety related system must be reinstalled or replaced within 72 hours of its removal or declare the supported system/component inoperable and follow the appropriate action statement for that system.

G. For inoperable snubber(s), within 72 hours, replace or restore inoperable snubber(s) to an operable status and perform an engineering evaluation on the supported component or system, if the snubber does NOT meet the functional test acceptance criteria of TSR 3.7.4.2. Otherwise, declare the system inoperable and follow the required actions specified in the TRM. The engineering evaluation is to determine if component or system restrained by the snubber(s) was adversely affected by inoperability of the snubber(s) during the previous operating cycle and ensure that the restrained component or system remains capable of meeting its design function. The engineering evaluation(s) for supported component or system analysis are to be recorded on Attachment 4.

1.3 Frequency/Conditions (continued)

H. Alternately, for a snubber removed and not replaced within 72 hours, or an inoperable snubber not replaced or restored within 72 hours, operability of the supported system maybe verified based on an engineering evaluation of the system functional capability with the removed or inoperable snubber.

I. Snubbers removed for maintenance or determined to be inoperable on a non-operable safety related system must be reinstalled or replaced, in accordance with MPI-0-000-SNB004 and tested in accordance with this instruction, prior to declaring the system operable.

J. For all subgroups, when subsequent testing is required, it shall continue within the respective subgroup until no failure is found.

K. New, replaced, or rebuilt snubber(s) shall meet the functional test acceptance criteria before their installation in the unit and must have been functionally tested "Satisfactory", within 12 months prior to their installation.

2.0 REFERENCES

A. Technical Requirements Manual TR 3.7.4, Snubbers

B. 1-SI-4.6.H-1, Surveillance Instruction Visual Examination of Hydraulic and Mechanical Snubbers

C. 2-SI-4.6.H-1, Surveillance Instruction Visual Examination of Hydraulic and Mechanical Snubbers

D. 3-SI-4.6.H-1, Surveillance Instruction Visual Examination of Hydraulic and Mechanical Snubbers

E. MPI-0-000-SNB004, Instructions for Removing and Reinstalling Pacific Scientific Mechanical, Bergen-Paterson, Anchor/Darling, Fronek, Grinnell Hydraulic and Bergen-Paterson or Lisega Torus Dynamic Restraint Snubbers

F. BFN-VTM-L329-0010, Vendor Technical Manual for Lisega Torus Dynamic Restraint Snubbers

G. BFN-VTD-L329-0070, Installation and Maintenance Instruction for Lisega Type 31 21 50 and Test (Surrogate) Type 31 Hydraulic Shock Absorber

H. PE-8997-P1, Special 4 Inch Tapered Pin Installation and Removal Procedure

I. 0-TI-398, Snubber Program Procedure

J. SPP-3.1, Corrective Action Program

2.0 REFERENCES (continued)

K. SPP-8.1, Conduct of Testing

3.0 PRECAUTIONS AND LIMITATIONS

None

4.0 PREREQUISITES

[1] Six months prior to each refueling outage, ensure a minimum of two(2) new Lisega Torus Dynamic Restraint snubbers have been tested and are ready for installation, if required. No paperwork is required, since these snubbers are NOT under the Section XI Repair and Replacement Program.

5.0 SPECIAL TOOLS AND EQUIPMENT RECOMMENDED

DESCRIPTION	SIZE	QUANTITY
AP 280 (Lisega Spec. No. 151)		As required
Snubber Test Machine	As required	1

6.0 ACCEPTANCE CRITERIA

A. Responses which fail to meet the following As-Found functional test Acceptance Criteria require immediate notification of the Shift Manager or Unit Supervisor at the time of failure.

B. The snubber functional test shall verify that:

NOTE
Activation, bleed, or drag force acceptance criteria may be other than that described in the steps below, if approved by Site Engineering on Attachment 5.

1. "As-Found"

   a. Activation occurs in both directions of travel at a piston velocity greater than or equal 6 inches/minute and less than or equal 25 inches/minute.

   b. Bleed takes place after activation of the snubber, in both tension and compression directions.

   c. Drag force does not exceed 15,000 pounds.

6.0 ACCEPTANCE CRITERIA (continued)

2. "As-Left"

   a. Activation occurs in both directions of travel at a piston velocity greater than or equal 6 inches/minute and less than or equal 25 inches/minute.

   b. Bleed takes place after activation of the snubber, in both tension and compression, and is greater than 0.24 inch/minute and less than 1.18 inches/minute.

   c. Drag force does not exceed 15,000 pounds.

C. The stroke setting shall be within the limits shown on the design drawing. Otherwise, complete Attachment 6.

D. There shall be no loose or missing fasteners for attachment of the "As-Found" dynamic restraint(s) to the component or the anchorage. Otherwise, complete Attachment 6.

E. Not meeting acceptance criteria for stroke setting, or loose or missing fasteners, does not require testing an additional lot equal to 10% of the subgroup of snubbers. Evaluation of snubber operability, corrective actions, and selection of other suspect snubbers for verification shall be as specified on Attachment 3 or Attachment 6, as applicable.

7.0 PROCEDURE STEPS

7.1 Training and Qualification of Performers

[1] Thorough briefing should be conducted on SI performance prior to starting.

[2] The cognizant individual or Snubber Engineer responsible for the performance of the Surveillance Instruction must be qualified as a test director.

[3] Appropriate General Employee Training (GET) (including respirator training) should be received by personnel prior to performing this SI.

7.2 Preparation of Test Data Package

[1] **SELECT** snubbers for retest which were placed in the same location as snubbers which failed during the previous outage, if the failure analysis showed that the failure was due to the location. However, these snubbers shall be tested in addition to the initial 10 percent test lot (sample plan).

[2] **DETERMINE** the initial test lot (sample plan) as follows:

- **SELECT** 10 percent of the snubbers from subgroup 5 (see Appendix A).
- In general, **SELECT** the snubbers with the most time from the previous test.
- **SELECT** snubbers that have experienced severe transients.
- **FILL OUT** the applicable section(s) of Attachment 2.

7.3 Removal of Valves From Restraint/Surrogate

NOTES

1) Before the existing valves are removed, record the "As-Found" stroke setting on Attachment 2. There must be no external forces exerted on the restraint, either in compression or tension.
2) Prior to removal of the existing valves ensure there are spare valves on hand which have been tested and passed their functional test within the past 12 months.
3) For valve removal, always remove the front valve 1st and the rear valve 2nd. For valve installation, always install the rear valve 1st and the front valve 2nd.

[1] **REMOVE** the hexagon screw, disk, bushing and lock plate from the face side of the valve body. See Illustration 1.

[2] **TURN** the 2-way ball valve positioner from the slot being in the vertical to the horizontal direction as shown in position 2, of Illustration 1. This disconnects the snubber main body cylinder from the rear valve.

[3] **REMOVE** the hex screws from the cover of the front valve. See Illustration 2.

NOTE

When lifting the valve the automatic shut-off valve between the pressurized reservoir and the restraint body interrupts the connection, so that the cylinder is no longer pressurized.

[4] **REMOVE** the front cover, then **REMOVE** the valve with the extraction tool. See Illustration 2.

[5] **CONNECT** a drain hose to the coupling at the snubber drain port shown in Illustration 3, on the interior face of the valve body.

[6] **DRAIN** the oil from between the valves. After draining is complete, **REMOVE** the drain hose.

[7] **REMOVE** the hex screws from the cover over the rear valve. See Illustration 2

[8] **REMOVE** the rear cover, then **REMOVE** the valve with the extraction tool. See Illustration 2.

7.4 Installation of the Valves in the Restraint/Surrogate

NOTES

1) Prior to installation of the tested valves all O-rings shall be checked and replaced, if necessary.
2) The screws for the valve covers are only to be tightened snug-tight.

[1] **ADD** AP 280 hydraulic fluid to the hole for the rear valve. The fluid level shall be approximately equal to the level shown in Illustration 4.

[2] **INSERT** the tested rear valve, then **REPLACE** the **COVER** over this valve and **SECURE** it with the lock washers and screws removed in Step 7.3[7]. See Illustration 2.

[3] **ADD** AP 280 hydraulic fluid to the hole for the front valve. The fluid level shall be approximately equal to the level shown in Illustration 4.

[4] **ENSURE** all of the air in the cross-tie line has been removed.

NOTES

1) At the installation of the front valve the shut-off valve to the reservoir opens automatically, repressurizing the restraint.
2) The front valve requires sufficient force added to insert it, due to the pressure on the shut-off valve from the reservoir.

[5] **INSERT** the tested front valve, then **REPLACE** the cover over this valve and **SECURE** it with the lock washers and screws removed in Step 7.3[3]. See Illustration 2.

[6] **TURN** the 2-way ball valve positioner from the slot being in the horizontal to the vertical direction, as shown in position 1 of Illustration 1. This connects the snubber main body cylinder to the rear valve.

[7] **REPLACE** the bushing, lock plate and disk. See Illustration 1.

7.4 Installation of the Valves in the Restraint/Surrogate (continued)

NOTE
Prior to the performance of the next step, it is required that parts to receive locking fluid (such as Loctite) are free of oil or grease.

[8] **APPLY** a small amount of locking fluid (such as Loctite) to the threads of the hex screw removed in Step 7.3[1].

7.5 "As-Found" and "As-Left" Functional Test Using STB-200 Test Machine

[1] **ENSURE** the test machine has been warmed up in accordance with Appendix C of this procedure.

NOTE
The word "Test SNUBBER" as used in this test means the Lisega Surrogate Snubber with properly installed valves in accordance with Section 7.4. The following describes a suggested procedure for "Testing a Surrogate Snubber" using the STB 200 Snubber Test Machine with the upgraded Windows Software Operations Manual.

[2] **POWERING UP THE TEST SYSTEM**

TURN ON the master power switch on the control console. Make sure that the computer, monitor, and printer are turned on.

TURN ON the main breaker on the Hydraulic Power Unit (HPU) located at the end of the power unit.

ENSURE that all emergency stop buttons are pulled out.

7.5 "As-Found" and "As-Left" Functional Test Using STB-200 Test Machine (continued)

[3] **STARTING THE SOFTWARE**

Once the computer has "Booted Up", the Windows Desktop will be displayed.

SELECT the "STB 200" icon and double click on it, this will Start the Test program. The LOG ON prompt window will appear.

ENTER you user name and password in either upper or lower case letters.

All functions required by the system are available in the screen, or from one of the Pull Down Menus at the top of the screen.

[4] **DAILY CALIBRATION CHECK**

PERFORM the daily calibration check, using Section 3.0 of Appendix C and sign the daily calibration form.

After the daily calibration check has been completed, and the Daily Calibration Report is "SATISFACTORY", proceed on testing a snubber.

[5] TESTING A SNUBBER

[5.1] **Pick the Snubber Type**

Using the Snubber Pull Down List in the User Supplied Information block, **SELECT** the Type Snubber to be tested.

[5.2] **Enter the Header Information**

FILL in the other information as indicated in the User Supplied Information block.

[5.3] **Running the Test**

[5.3.1] **Pick the Test**

CLICK on the Type of Test (i.e., "As-Found" or "As-Left") as desired.

7.5 "As-Found" and "As-Left" Functional Test Using STB-200 Test Machine (continued)

[5.3.2] **Start the Test**

CLICK on the Start Test button. If this is the first test performed on the snubber, the following two windows will appear:

[5.3.3] **Tare weight Window**

This window allows the User to "zero out" any offset load that the load cell may be reading. This should be performed BEFORE installing the snubber in the test bench. Wait for the "Raw Reading" to settle (as far as possible), and then Click "Adjust Load Cell". The "Adjustment" will be updated, and the "Adjusted Reading" should now read close to zero (0) lb. The "Adjust Load Cell" button may be Clicked again if a new adjustment value is desired. Once the readings are as desired, Click the "Continue" button.

ENSURE the correct load cell is connected to the machine.

CHOOSE the proper bushings and pins for the snubber being tested, then **INSTALL** the bushings in both clevis attachments on the machine.

[5.3.4] **Stroke and Position Window**

INSTALL the snubber in the test bench, with the piston or operable end toward the drive piston of the machine, if possible. Adjust the backstop and/or use the Jog Speed Slider to adjust the bench and the driver cylinder to the desired pin to pin dimension. The jog slider adjusts the jog speed. The joystick on the test frame controls the actual motion of the driver.

INSTALL the pins through the bushings and the snubber spherical bearings.

With the surrogate snubber installed in the horizontal position, **REMOVE** any tested valves from the surrogate snubber using the steps in Section 7.3, as appropriate.

7.5 "As-Found" and "As-Left" Functional Test Using STB-200 Test Machine (continued)

> **NOTE**
>
> A small amount of AP 280 Silicon hydraulic fluid may have to be added to the hole for the front valve. The oil level should be approximately at the upper edge of the connection bore between the front and rear valve. This can also be accomplished by opening the shut-off-valve by hand.

INSERT the valves removed from the existing restraint to be tested, using the steps in Section 7.4, as appropriate.

ONCE the snubber has been pinned and the valves installed, the snubber's piston position (distance from the fully retracted position) should be accurately measured (within 0.1 inch) and entered in the SNUBBER EXTENSION window.

If the test program calculates that it cannot fully extend or fully retract the snubber during drag testing, one or more of the text windows on the screen will be highlighted in red. If this happens, the backstop will have to be adjusted and the snubber extension recalculated.

The program calculates whether it can fully test the snubber through its stroke range. It will display the two ends of stroke (minus a 1/2 inch safety zones), the calculated center position and the bottomed out position for the snubber.

Once the data has been successfully entered, **TIGHTEN** the lock nuts on the load cell threaded rod snug tight to prevent slippage during the test.

ENTER the snubber UNID number, WO number, system number, serial number, and test equipment information on Attachment 2 as required, and Click on "Continue with Test" to continue the test.

7.5 "As-Found" and "As-Left" Functional Test Using STB-200 Test Machine (continued)

[5.3.5] If an Activation Test is Selected

After all the above steps have been completed, and PRIOR to starting the test (i.e., "As-Found" Activation Test), the test program will initiate a routine to set and stabilize the hydraulic system pressure at a calculated level sufficient to achieve the requested test load. During this period, the setpoint and actual pressures are displayed, along with the output voltage, and a "count down" value. When the pressure is near the desired value, the countdown value will decrement towards zero. If the pressure fluctuates out of limits, the countdown will reset to six. Once the pressure is stable enough to let the countdown complete, the test will begin automatically.

- **OBSERVE** that the snubber activates in both directions to establish operability of the snubber in the "As-Found" condition.

- **RECORD** all necessary information on Attachment 2, as appropriate.

NOTE
Forcing a test may allow the machine to overstress the snubber during the test!

If the user wishes to force a test, clicking the "Force the Test" button will initiate the test regardless of pressure.

Clicking the "Abort the Test" button will cause the test cycle to abort without performing the test.

7.5 "As-Found" and "As-Left" Functional Test Using STB-200 Test Machine (continued)

[5.3.6] **If Drag Test is Selected**

If a Drag Test (i.e., ID, AC, and FD test sequence for "As-Left", and AC, FD test sequence for "As-Found" test) is selected, the test system will automatically begin the drag test. The system will determine the starting position of the snubber, and choose the initial test direction to move towards the farthest end of stroke. The drag speed will be automatically controlled to the target speed set earlier. This test is to **VERIFY** free travel of the piston rod through its full stroke. The Raw Test Data graphed in real time is reviewed to:

- **VERIFY** that freedom of movement is NOT restricted, and drag force of the snubber does not exceed 15,000 pounds.

- **RECORD** this information on Attachment 2, as appropriate.

[5.3.7] **Printing the Results**

After the test on the surrogate snubber is complete, the calculations appropriate to that test are performed and the results are displayed on the screen.
This allows the user to review and determine if the "As-Found" test results meet the "As-Found" acceptance criteria in Section 6.0B, or Section 6.0B.2 for the "As-Left" test, and plot the test results.

For Activation tests on acceleration limiting snubbers only, the calculated acceleration lines will be printed if they are displayed on the graph when printing is requested.

- If the results are within the acceptance range for the type of test performed, **THEN**

CLICK on the "Print Test" button to open the standard Windows printer dialog box. **SELECT** the proper printer, and **CLICK** "OK" to start the printing.

- **ATTACH** the Printed Results of the surrogate snubber tests in Attachment 2, as part of the work package.

CONVERT the surrogate snubber test results to the Lisega Large Bore (Type 31 21 50) values, using the conversion factors and nomenclature in Attachment 2.

VERIFY that the converted values meet the acceptance criteria, and **RECORD** in Attachment 2.

7.5 "As-Found" and "As-Left" Functional Test Using STB-200 Test Machine (continued)

[5.3.8] **Saving the Test Results**

To save a test file to disk, click the "Save Test" button. This saves the test results in the "test_data" directory. The file name of the saved test result is as follows:
Work_Order_number Serial_number Test_Date Test_Type.csv

Where:
Work_Order_number is the value entered in the work order number entry
Serial_number is the value entered in the serial number entry
Test_Date is the date when test was performed
Test_Type is ID for initial drag tests, AC for activation tests and FD for final drag tests.
Tests are saved as comma separated variable files and may be directly loaded into Excel or similar spreadsheet programs as desired.

[5.3.9] **Running Another Test**

CLICK on the Type of test to be performed. The results of the last test will be erased, and the graph will rescale for the test to be done.

- **REPEAT** the procedure from Step 7.5[5.3.2] to complete Running Another Test (i.e., the "As-Left"), as needed.

[5.3.10] **Testing Another Snubber**

SELECT a new snubber type, if necessary, from the snubber pull down list. If a snubber of the same type is to be tested, the user has to only change the serial number, hanger number, and work order entries.

- **REPEAT** this procedure from Step 7.5[5.3.1] to complete Testing Another Snubber.

7.5 "As-Found" and "As-Left" Functional Test Using STB-200 Test Machine (continued)

NOTES
1) At this time the machine has completed Running the Test. Unless you are leaving the building, leave the machine running so it will NOT have to be warmed up to perform another test (i.e., the "As-Left" test as needed).
2) Do NOT shutdown the console power without exiting Windows properly.

[5.4] **Quitting and Shutting Down the System**

TURN OFF the 480Vac power on the HPU. On the computer screen, **SELECT** EXIT from the File Menu. When the Windows screen appears, **CLICK** on START, then **SHUTDOWN**, and click on **SHUT DOWN** the Computer, then **CLICK** OK. When the computer has completely shutdown, **TURN OFF** the main power switch on the current control consoles.

[6] **DETERMINE** if the "As-Found" test result values as CONVERTED for the Lisega Large Bore snubber (Type 31 21 50) meet the acceptance criteria in Section 6.0B.1.

[7] **IF** the CONVERTED test result values for the Lisega Large Bore snubber (Type 31 21 50) meet the "As-Found" acceptance criteria, **THEN**

ENTER the information on Attachment 2.

PLACE the tested valves in storage until needed.

[8] **IF** the CONVERTED test result values meet the "As-Left" Acceptance Criteria in Section 6.0B.2, **THEN**

ENTER the information on Attachment 2.

7.5 "As-Found" and "As-Left" Functional Test Using STB-200 Test Machine (continued)

[9] **IF**, based on the As-Found test results, a snubber is determined to be inoperable, including case specific criteria, **THEN**

- **NOTIFY** the Shift Manager or Unit Supervisor immediately.
- **REQUEST** a failure analysis on Attachment 3 and a supported component or system analysis on Attachment 4, as necessary.
- **DETERMINE** the subsequent test lot (sample plan), as required.
- **SELECT** the number of restraints equal to 10 percent of the remaining snubbers in that subgroup.
- In general, **SELECT** the restraints with the most time from the previous test.
- **FILL** OUT ALL applicable sections of Attachment 2, as required.
- **ENSURE** test data package is ready for Shift Manager/Unit Supervisor authorization.
- **PERFORM** applicable functional test for the subsequent test lot (sample plan).

7.6 Results Evaluation

NOTE
The following reviews are usually performed by the Snubber Engineer/SE Designee, or a Site Engineering Civil representative:

[1] **REVIEW** all of the test data on Attachment 2, as applicable.

[2] **IF** any snubber is determined to have been inoperable, **THEN**

- **ENSURE** that the Shift Manager/Unit Supervisor has been notified of the inoperable snubber.
- **INITIATE** a PER in accordance with SPP-8.1 and SPP-3.1.
- **INITIATE** a WO to replace or rebuild the snubber, if necessary.
- **PERFORM** a failure evaluation of any inoperable snubber and **DOCUMENT** on Attachment 3.
- **PERFORM** the supported system or component evaluation on Attachment 4.
- **SELECT** the subsequent test lot as required for functional test failure, or other snubbers for verification, as specified on Attachment 6.

7.7 Data Sheet Review

[1] **VERIFY** all of the necessary Attachments are included and all acceptance criteria have been met.

[2] **REVIEW** the completed SI package for final acceptance.

NOTE
Computer generated data sheets containing information regarding the initial test log, subsequent test logs, rebuild, etc., should be submitted with the SI data package.

[3] **SUBMIT** the completed data package for closure.

8.0 ILLUSTRATIONS/APPENDIX/ATTACHMENTS

Illustration 1 - Two Way Ball Valve Locations and Positions

Illustration 2 - Cover and Valve Removal and Reinstallation

Illustration 3 - Drain Hose Connection

Illustration 4 - Oil Level in Valve Hole Prior to Replacing the Removed Valve

Illustration 5 - Fluid Level in Surrogate Test Snubber Holes

Illustration 6 - Lisega Fluid Level Measurement of Surrogate Test Snubber

Illustration 7 - Lisega Piston Position Measurement

Illustration 8 - Lisega Minimum Fluid Level Plunger and Piston Position Measurement in the Field

Appendix A - Sub-grouping and Service Life Monitoring of Snubbers

Appendix B - Common Modes of Snubber Failure and Possible Causes

Appendix C - Daily Startup Procedure for the STB-200 Test Bench

Attachment 1 - Surveillance Instruction Review Form

Attachment 2 - Nomenclature, Conversion, As-Found and As-Left Test Data, Removal and Reinstallation Data Sheets for Lisega Large Bore Torus Dynamic Restraints

Attachment 3 - Engineering Failure Analysis for Inoperable Snubbers

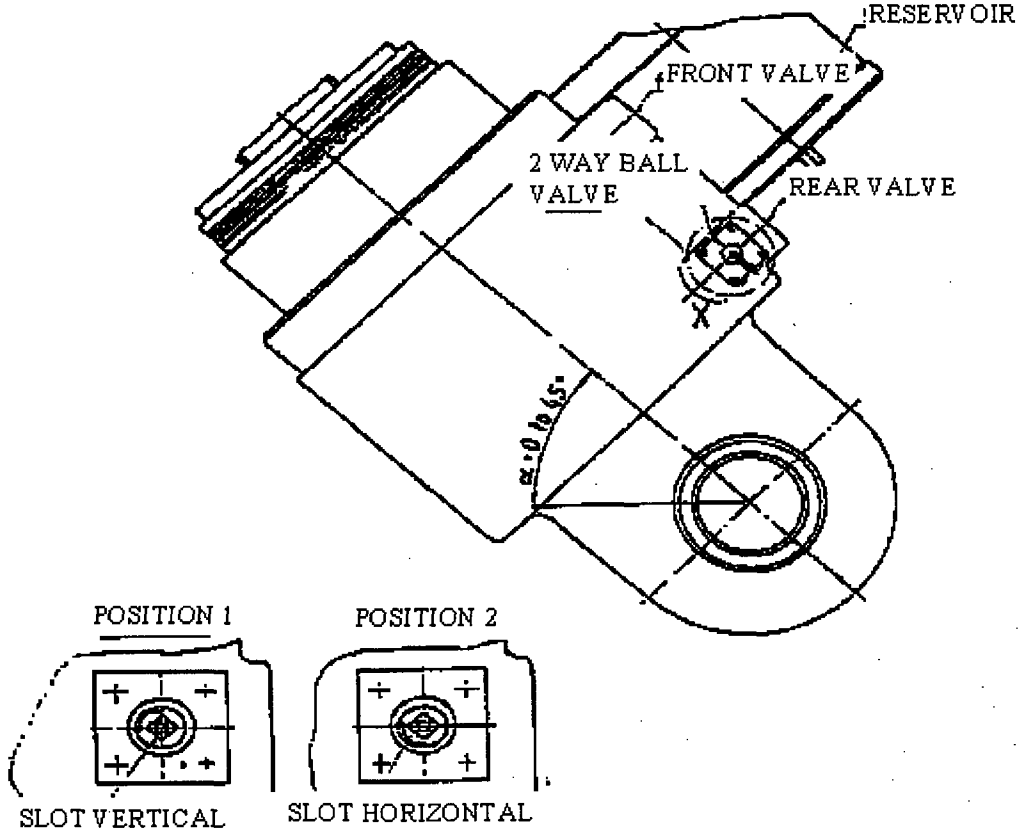
Attachment 4 - Supported Component or System Analysis for Inoperable Snubbers

Attachment 5 - Functional Test Case Specific Acceptance Criteria

Attachment 6 - Evaluation of Loose or Missing Attachment Fasteners, or of “As-Found” Stroke Setting Outside of Acceptable Range

Illustration 1
(Page 1 of 1)

Two Way Ball Valve Locations and Positions



2 WAY BALL VALVE

Illustration 2
(Page 1 of 1)

Cover and Valve Removal and Reinstallation

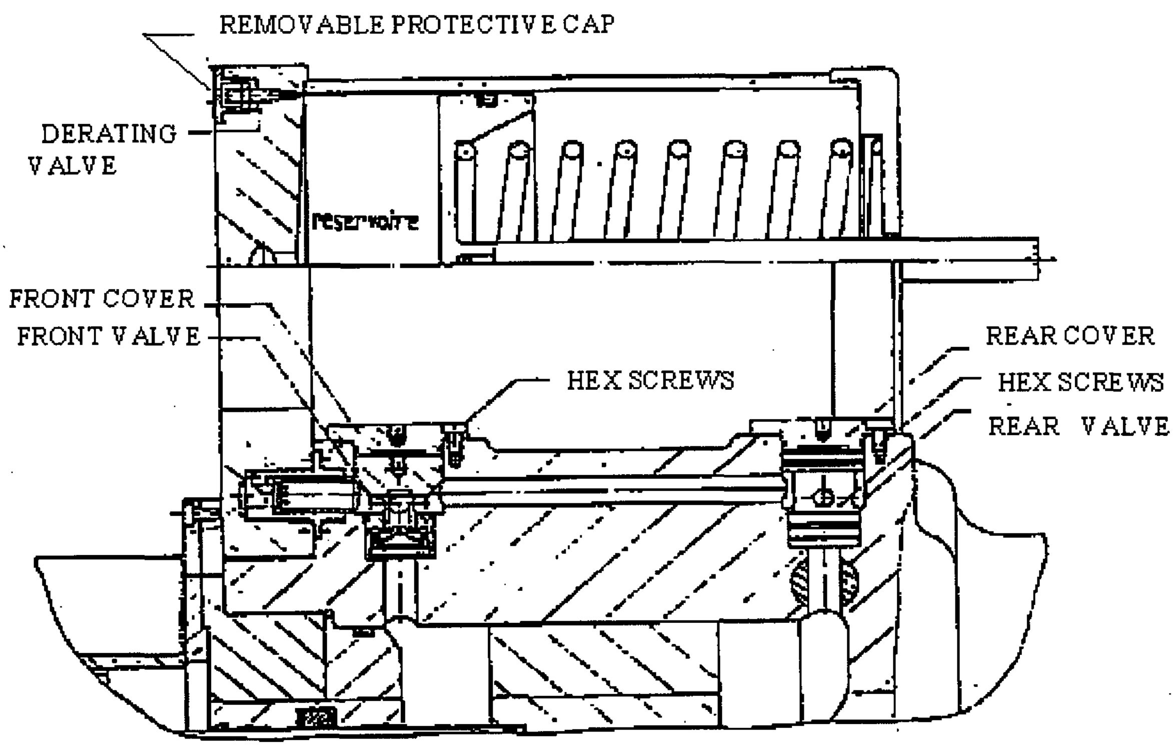


Illustration 3
(Page 1 of 1)

Drain Hose Connection

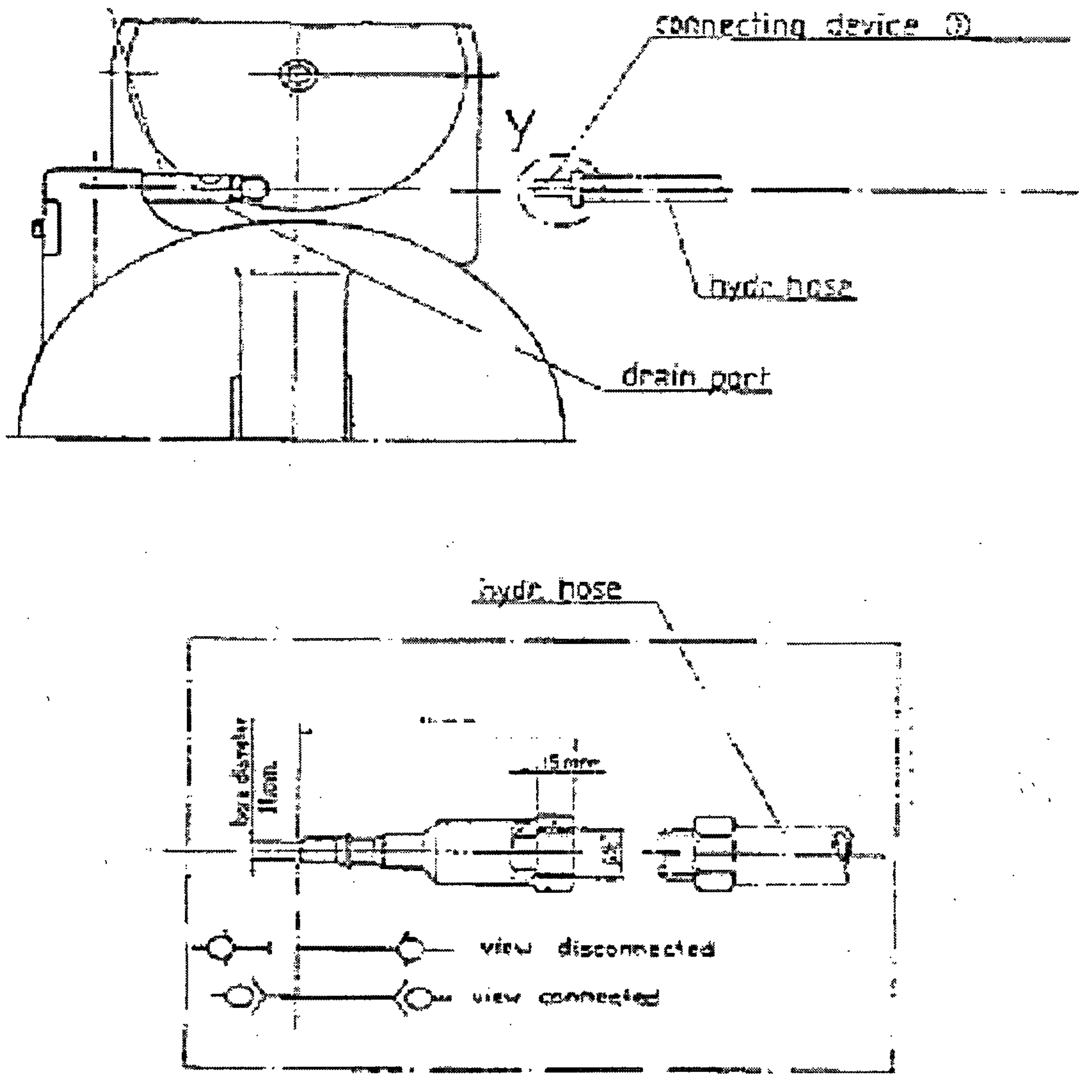


Illustration 4
(Page 1 of 1)

Oil Level in Valve Hole Prior to Replacing the Removed Valve

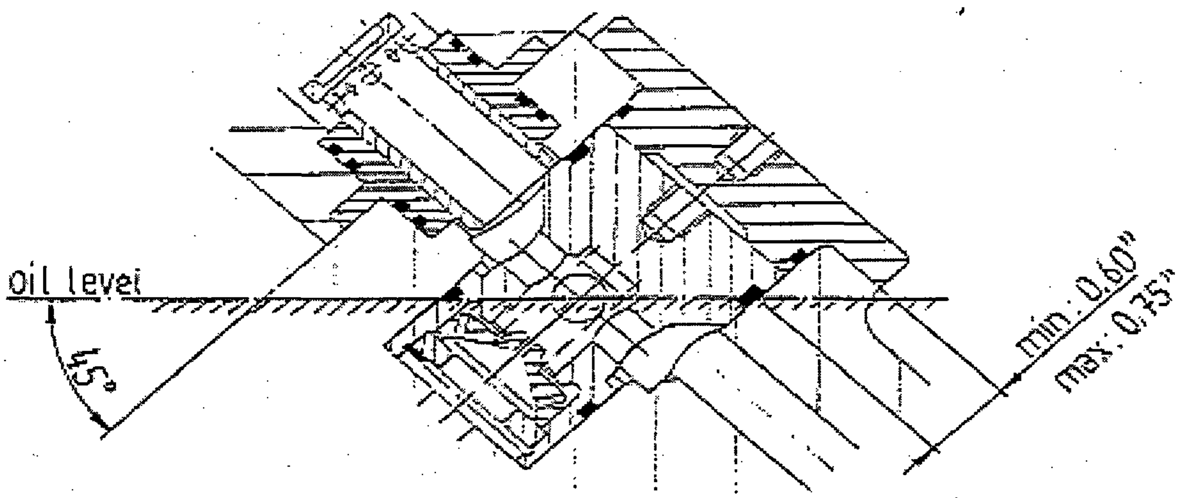
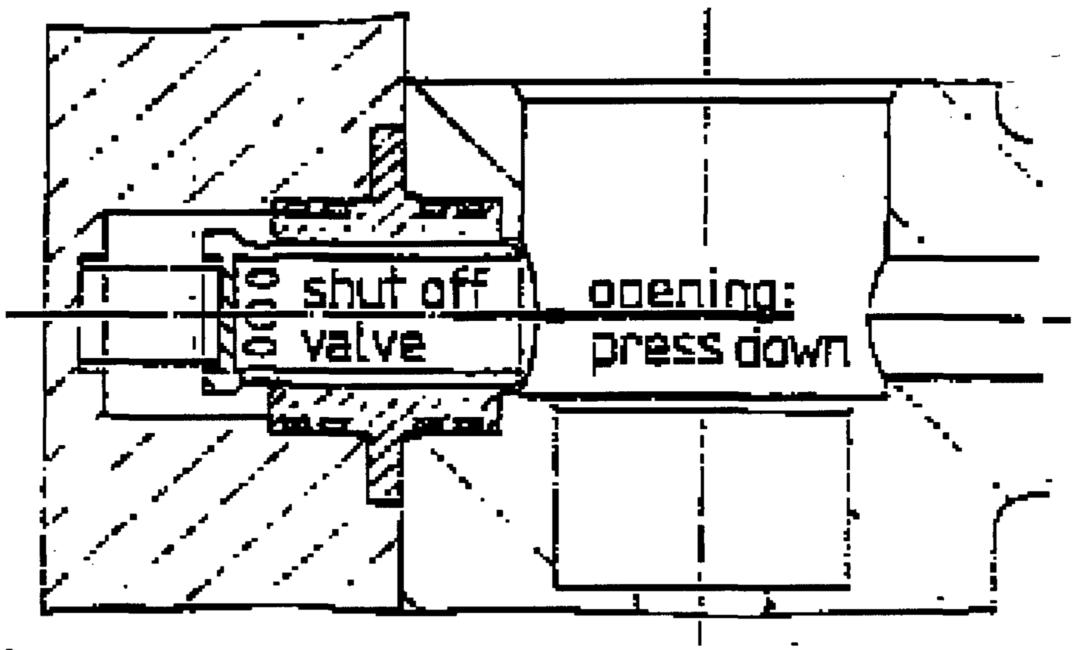


Figure 2: Oil level in front valve before replacing the removed valve (rear valve: identical oil level)

Illustration 5
(Page 1 of 1)

Fluid Level in Surrogate Test Snubber Holes



OIL LEVEL SHOULD BE AT THE UPPER EDGE OF THE CONNECTION BETWEEN THE FRONT AND REAR VALVE.

Illustration 6
(Page 1 of 1)

Lisega Fluid Level Measurement of Surrogate Test Snubber

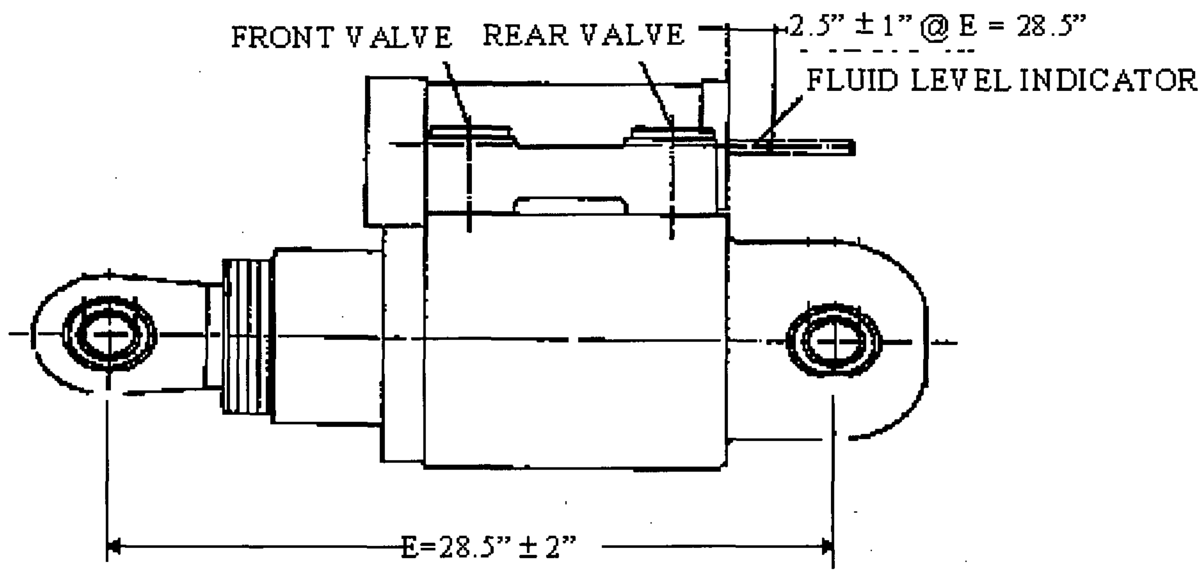


Illustration 7
(Page 1 of 1)

Lisega Piston Position Measurement

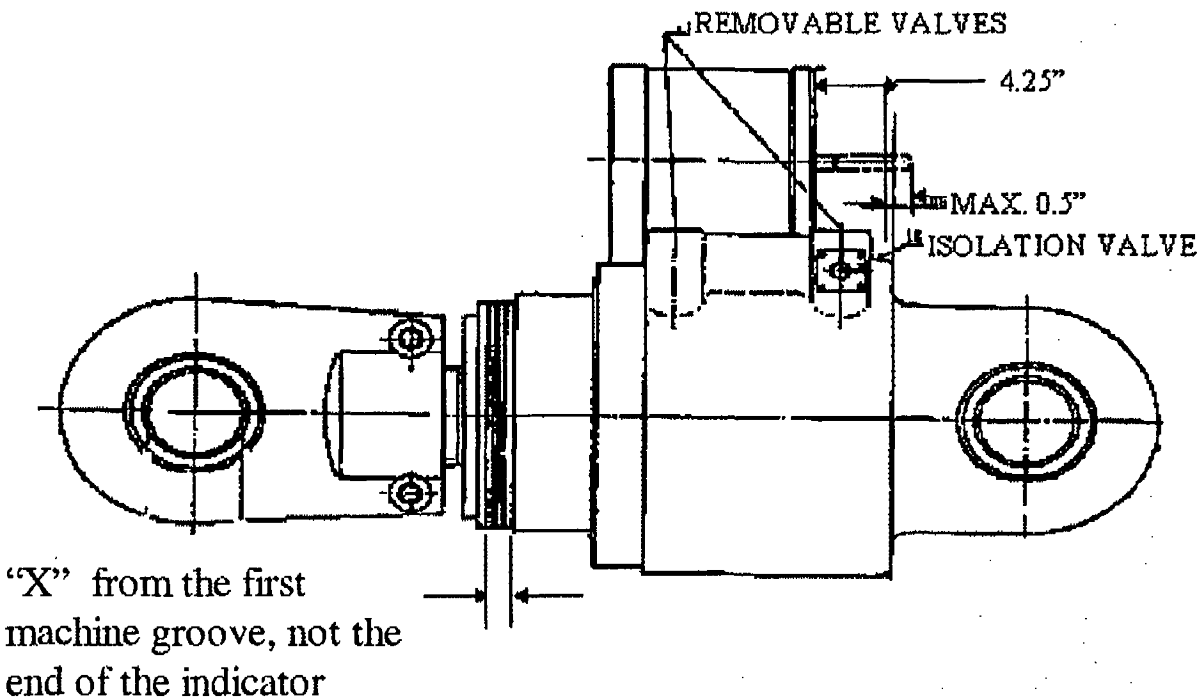


Illustration 8
(Page 1 of 2)

Lisega Minimum Fluid Level Plunger and Piston Position Measurement in the Field

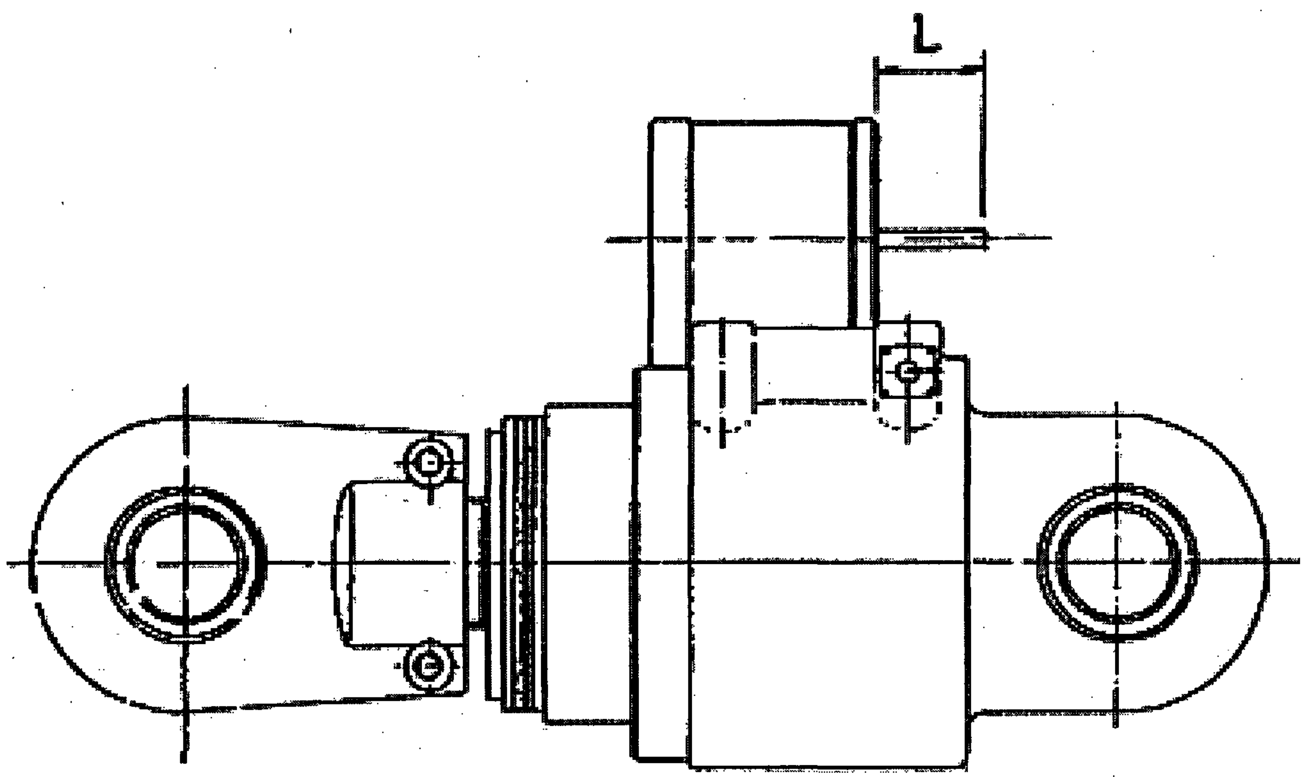


Illustration 8
(Page 2 of 2)

Lisega Minimum Fluid Level Plunger and Piston Position Measurement in the Field

If the as-found Reservoir plunger position “L” is below the minimum value given, the fluid level is unacceptable. ADD AP 280 Silicon hydraulic fluid to the snubber to bring the reservoir, as close as possible, to its optimum (maximum) level. No functional testing of the Lisega Torus Dynamic Restraint Snubber is required due to this refilling operation.

Nomenclature:

X - Measurement of the piston position in inches from the front head of the snubber to the first machined groove on the indicator, NOT the end (See ILLUSTRATION 7).

L Minimum - The minimum fluid level in the reservoir for the piston position measured from the front of the reservoir to the end of the reservoir piston rod.

L Maximum - The maximum fluid level in the reservoir for the piston position measured from the front of the reservoir to the end of the reservoir piston rod.

If the “X” measurement shown in Illustration 7 is between the numbers given in the table below for “X”, then go to the next lower reading for “X” to determine the L Minimum and L Maximum.

“X” (INCHES)	L MINIMUM (INCHES)	L MAXIMUM (INCHES)
0.000	2.49	3.27
0.125	2.39	3.18
0.250	2.30	3.09
0.375	2.21	3.00
0.500	2.12	2.91
0.625	2.03	2.81
0.750	1.93	2.72
0.875	1.84	2.63
1.000	1.75	2.54
1.125	1.66	2.45
1.250	1.57	2.35
1.375	1.47	2.26
1.500	1.38	2.17

Appendix A
(Page 1 of 1)

Subgrouping and Service Life Monitoring of Snubbers

1.0 SUBGROUPINGS

For functional testing, the snubbers belong to one subgroup as described below:

Subgroup 5 — Bergen-Paterson and Lisega Torus Dynamic Restraint hydraulic snubbers. For functional testing of Bergen Paterson snubbers, see 0-SI-4.6.H-2C.

When snubbers are added, deleted, or changed, based on modifications, they are added or deleted from their appropriate subgroups. If the added snubbers do NOT fit an existing subgroup, a revision to this SI describing the new subgroup or a revision to an existing subgroup is required.

There have been no failures of snubbers from subgroup 5; therefore, testing 10 percent of the snubbers in these areas each refueling outage satisfies the intent of the surveillance requirement.

Appendix B
(Page 1 of 1)

Common Modes of Snubber Failure and Possible Causes

TYPE	COMMON MODES OF FAILURE	POSSIBLE CAUSE
HYDRAULIC	No Lockup	Wrong size poppet Wrong size poppet spring Poppet frozen or blocked open Excessively low or no fluid Lockup adjustment set improperly Damaged piston rod seal Damaged O-ring
	High Lockup	Wrong size poppet Wrong size poppet spring lockup velocity Adjustment set improperly Damaged O-ring
	Low Lockup	Broken poppet spring Poppet frozen or blocked closed Lockup velocity Adjustment set improperly Foreign objects in fluid
	High Bleed	Defective or damaged poppet Defective or damage poppet seat Wrong size poppet Bleed adjustment set improperly Damaged O-ring
	No Bleed	Foreign objects in fluid Bleed adjustment set improperly
	Miscellaneous	Hardware. Improper installation Improper handling or abuse Misapplication. Overload Vibration or wear

Appendix C
(Page 1 of 3)

Daily Startup Procedure for the STB-200 Test Bench

1.0 DAILY STARTUP PROCEDURE

[1] WARM-UP

Exercise both benches (i.e., small and large) by selecting the Manual Control Panel function from the Tool Menu. Clicking on "Auto Exercise" in the Operating Mode block will cause the selected bench to automatically stroke back and forth. The system should be run this way until the oil temperature is above approximately 70°F or smooth operation is attained. Both test benches should be exercised. To change from one bench to the other, click on the bench label.

[2] CHECK THE PRESSURE TRANSMITTER

NOTE
This instrument does NOT provide safety-related data. This check is optional.

In the Manual Control Panel mode, **SELECT** Manual in the Operating Mode block. Turn the "HP Pump" on, then use the HP Pump slider to increase the pressure command setting until the "Pressure" reading is approximately 2000 psi. **CHECK** the 0-3000 psi gauge in the front of the HPU. The two readings should be within ~ 200 psi.

[3] PARK THE RAM

SELECT the "Park the Ram" to prepare the bench for the Daily Calibration Check. This should be done for both benches.

[4] SHUT DOWN THE MANUAL CONTROL PANEL

Click on "SHUT DOWN" to exit the Manual Control Panel.

Appendix C
(Page 2 of 3)

Daily Startup Procedure for the STB-200 Test Bench

2.0 STATUS CHECK

A. During the warm-up period, the frame drive cylinders should be stroked using the proportional valve and/or the jog/drag valve.

B. The system should be checked for loose fittings, bolts, etc.

C. The filter indicators should be watched during cylinder stroking to ensure that they are not illuminating.

D. If the indicators are illuminating, the filters should be changed before continuing with operation of the machine or any testing.

3.0 DAILY CALIBRATION CHECKS

The following calibration checks assure the functionality of the instrument and Data Acquisition and control System (DAS) for testing. They do NOT take the place of full system calibrations which must be performed on a periodic basis.

The instrument system (DAS system and transmitters) should be powered up for 30 minutes before any checks or testing is performed.

Prior to performing this function, both rams should have been "Parked" using the "Park the Ram" function in the Manual Control Panel.

[1] **SELECT THE DAILY CALIBRATION FUNCTION**

SELECT the Daily Calibration Check function from the "Tools" menu.

[2] **CONNECT THE LOW RANGE LOAD CELL AS DIRECTED**

If directed to by the software, electrically connect the Low Range Load Cell as instructed. The load cell does not need to be mechanically mounted in the test bench, but it must be connected to its electrical cable.

[3] **STORE THE "ZERO" CALIBRATION READINGS**

For each instrument click the "STORE" button in the "ZERO" column on the Daily Calibration screen for that instrument. The zero reading will be captured in the "Actual" "Zero" column. If it is within limits, the box will turn gray. If it is not within limits, the box will turn yellow.

Appendix C
(Page 3 of 3)

Daily Startup Procedure for the STB-200 Test Bench

3.0 DAILY CALIBRATION CHECKS (continued)

[4] **STORE THE "SPAN" CALIBRATION READINGS**

For each instrument, press in the "CAL" button on the front of the instrument, then click the "STORE" button in the "SPAN" column on the Daily Calibration screen for that instrument. The span reading will be captured in the "ACTUAL" "SPAN" column. If it is within limits, the box will turn gray. If it is *not within limits, the box will turn yellow.*

[5] **PRINT THE REPORT**

When all readings for both benches have been stored, click on the "PRINT" button to print the Daily Calibration Report. If the report is "SATISFACTORY", continue the testing. If the report is "UNSATISFACTORY", halt and correct the problem before continuing.

Attachment 1
(Page 1 of 1)

Surveillance Instruction Review Form

REASON FOR TEST:
☐ Scheduled Surveillance
☐ System Inoperable (Explain in Remarks) UNIT MODE ______________
☐ Maintenance (See WO No. below)
☐ Other (Explain in Remarks)

W.O. NO. ________________ SNUBBER UNID ________________ SERIAL NO. ______________

PRE-TEST REMARKS: ____
____
____

PERFORMED BY:

Initials	Name (Print)	Name (Signature)

NOTE: The following entries for contacting Shift Manager/Unit Supervisor shall be marked N/A if the snubber is NOT Inoperable.
NOTIFY Shift Manager/Unit Supervisor when snubber found Inoperable. __________
SM/UNIT SUPERVISOR CONTACTED ____________________ Date________ Time ________

NOTIFY Shift Manager/Unit Supervisor when snubber Operability is restored. __________
SM/UNIT SUPERVISOR CONTACTED ____________________ Date________ Time ________

MECHANICAL MAINTENANCE REVIEWER ____________________ Date ________

Signature attests that I understand the scope and purpose of this instruction and that, to the best of my knowledge, it was properly performed in accordance with instruction in that: the recording, reduction, and evaluation of data is complete and correct; acceptance criteria is met or justification for exceptions is provided; portions of test performed were appropriate for specified test conditions or reasons for test; deficiencies were evaluated and dispositioned; reportability was evaluated; marginal results were evaluated with respect to potential for future problems based on operating experience and regulatory requirements; and instruction was complete except as noted in post-test remarks.

SNUBBER ENGINEER/SITE ENGINEERING CIVIL REVIEWER ____________________ Date ________

SCHEDULING COORDINATOR ____________________ Date ________

POST-TEST REMARKS: ____
____
____

Attachment 2
(Page 1 of 5)

Nomenclature, Conversion, As-Found and As-Left Test Data, Removal and Reinstallation Data Sheets for Lisega Large Bore Torus Dynamic Restraints

NOMENCLATURE

	TYPE 312150	TEST/SURROGATE SNUBBER
FORCE OF SNUBBER	F_S	*F_T
LOCK-UP VELOCITY (ACTIVATION VELOCITY)	**V_{LS}	*V_{LT}
BY-PASS VELOCITY (RELEASE/BLEED RATE)	**V_{BS}	*V_{BT}

1. F_S value of 247 kips may be used as excerpted from Vendor Document Number: BFN-VTD-L329-0070.

CONVERSION

Lock-up

Lock-up velocity, in Tension: V_{LS} Tension = 0.59 × V_{LT} Tension

V_{LS} Tension = 0.59 × __________ = ________

Lock-up velocity, in Compression: V_{LS} Comp = 0.69 × V_{LT} Comp

V_{LS} Comp = 0.69 × __________ = ________

By-pass velocity

By-pass velocity, in Tension:

$$V_{BS}\ \text{Tension} = 0.37 \times V_{BT}\ \text{Tension} \times \sqrt{\frac{F_S}{F_T}}$$

V_{BS} Tension = 0.37 × ______ × ______ = ________

By-pass velocity, in Compression:

$$V_{BS}\ \text{Comp} = 0.39 \times V_{BT}\ \text{Comp} \times \sqrt{\frac{F_S}{F_T}}$$

V_{BS} Comp = 0.39 × ______ × ______ = ________

Snubber Engineer / SE Designee ________________________________

*-Data from the "Printed Test Result" of a functional test performed on Lisega Test/Surrogate snubber.

**-CONVERTED value resulting from the above conversion for the Lisega (Type 312150) restraint.

Attachment 2
(Page 2 of 5)

AS-FOUND TORUS DYNAMIC RESTRAINT TEST DATA

W.O. No. ____________________ Date: ____________

Snubber UNID ____________________

Serial Number: ____________________

Exam Number: ____________________ Load Cell No. ____________________

Snubber Rated Load: ______________ Calibration Due Date: ____________

	Activation (in/min)	Generic Acceptance Criteria*	Performer Signature/ Date
Tension Compression	________ ________	6 in/min ≤ Activation ≤ 25 in/min	Signature________________ Date__________(AC)
	Bleed (in/min)		
Tension Compression	________ ________	Bleed takes place after snubber activation	Signature________________ Date__________(AC)
	Drag (lbs)		
Tension Max:	____________	MAXIMUM 15,000 Pounds	Signature________________ Date __________(AC)
Compression Max:	____________		
Copy of the plotted As-Found test results is attached to this data sheet.			_______/______ Initials / Date

* Case specific Acceptance Criteria may be approved on Attachment 5.

Snubber meets Generic Acceptance Criteria: ____Yes ____No _______/______ Initials / Date

Snubber meets Case Specific Acceptance Criteria: __Yes __No __NA _______/______ Initials / Date

If neither the Generic nor Case Specific acceptance criteria have been met, Notify the Shift Manager or Unit Supervisor immediately.

______________________________ ____________

SNUBBER ENGINEER/SE DESIGNEE Date

Attachment 2
(Page 3 of 5)

AS-LEFT TORUS DYNAMIC RESTRAINT TEST DATA

W.O. No. ____________________ Date: ______________

Snubber UNID ______________________

Serial Number: ______________________

Exam Number: ______________________ Load Cell No. ____________________

Snubber Rated Load: Calibration Due Date: ______________

	Activation (in/min)	Acceptance Criteria*	Performer Signature/ Date
Tension Compression	________ ________	6 in/min ≤ Activation ≤ 25 in/min	Signature________________ Date__________(AC)
	Bleed (in/min)		
Tension Compression	________ ________	Bleed follows Activation, shall be in the range of 0.24 in/min - 1.18 in/min	Signature________________ Date__________(AC)
	Drag (lbs)		
Tension Max:	___________	MAXIMUM 15,000 Pounds	Signature________________ Date __________(AC)
Compression Max:	___________		
Copy of the plotted As-Left test results is attached to this data sheet.			_______/______ Initials / Date

* Case specific Acceptance Criteria may be approved on Attachment 5.

Snubber meets Generic Acceptance Criteria: ____Yes ____No _______/______
Initials / Date

______________________________ ____________
SNUBBER ENGINEER/SE DESIGNEE Date

Attachment 2
(Page 4 of 5)

REMOVAL OF LISEGA TORUS DYNAMIC RESTRAINTS

W.O. No. ____________________ Unit _______ Snubber UNID No. ______________

Serial No. _____________ Subgroup ___________ Test Lot: ___ Initial ___ Subsequent

Exam No. ______ Size ___________ Rated Load ________ lbs.

Design drawing number ________________________

Shift Manager/Unit Supervisor and Snubber Engineer/SE Designee notified prior to removal of restraint for functional testing.

______________________________ __________ __________
Foreman/Designee Date Time

As-Found Stroke/Piston Setting_______

Required Stroke/Piston Setting Range_______
(from Design drawing)

The As-Found Stroke Setting is within the acceptable limits shown in the design drawing listed above.

______ Yes ______ No ______________________________ __________ (AC)
Performer Signature Date

All fasteners for the As-Found snubber are secured and acceptable (i.e., no loose or missing fasteners on the component anchorage).

If the answer is "No", complete Attachment 6.

______ Yes ______ No ______________________________ __________ (AC)
Performer Signature Date

Attachment 2
(Page 5 of 5)

REINSTALLATION OF LISEGA TORUS DYNAMIC RESTRAINTS

W.O. No. ____________________ Unit _______ Snubber UNID No. ________________

Snubber reinstallation:

Same snubber reinstalled	____ Yes	____ No	
If No, enter Lisega TDR serial number	________________________	Serial Number (Lisega TDR)	
Snubber is reinstalled in proper location	____ Yes	____ No	
Snubber is reinstalled with base of housing up	____ Yes	____ No	
All locking devices are secured	____ Yes	____ No	
Cotter pins are spread	____ Yes	____ No	____ N/A
Spherical bearing greased	____ Yes	____ No	____ N/A
Gaps between spacers and spherical bearing are 1/16 inch each side, 1/8 inch total or less	____ Yes	____ No	
Snubber is tagged	____ Yes	____ No	
Bolts and jam nuts torqued	____ Yes	____ No	____ N/A
Anti-seize compound applied, as needed	____ Yes	____ No	____ N/A
As-Left Stroke Setting ________________			

See Attachment 4 of MPI-0-000-SNB004 for Torque Wrench Documentation

____________________________ ____________
Performer Signature Date

The As-Left Stroke Setting is within the acceptable limits shown in the design drawing as verified.

_____ Yes _____ No ____________________________ ____________
Performer Signature Date

SHIFT MANAGER/UNIT SUPERVISOR notified of operable and reinstalled snubber.

____________________________ ____________ (AC)
Foreman/Designee Date

Remarks: ____

____

____

Attachment 3
(Page 1 of 2)

Engineering Failure Analysis For Snubber Declared Inoperable

WO No. ________________ Unit __________ Snubber UNID No. ________________

Subgroup No. ___________ PER No. _____________ Mfg./Size ________________

Serial No. _____________ Rated Load __________ Exam No. ________ Lot______

1. Describe the mode of failure as discussed on Appendix B.
   ☐ Locked up ☐ High Drag Force ☐ Snubber would not activate
   ☐ Damage to snubber hardware ☐ Other
   Explain (if necessary)

2. Describe the conditions of the failure:

3. Determine the cause of the failure, using Appendix B for the possible causes (disassembly of the snubber may be necessary):

4. For a snubber that does not activate, release, is locked up, damaged hardware, was the cause of the failure a design or manufacturing defect? ☐ Yes ☐ No
   Explain evaluation:

Attachment 3
(Page 2 of 2)

WO No. ________________ Unit __________ Snubber UNID No. ________________

Subgroup No. ___________ PER No. _____________ Mfg./Size ________________

Serial No. ______________ Rated Load __________ Exam No. ________ Lot______

5. Snubber Failure classified as: ☐ Location ☐ Manufacturing ☐ Design ☐ Unknown

   ☐ Other

   Explain:

6. Does the vendor need to be contacted? ☐ Yes ☐ No
   Vendor Name:
   Person contacted: Date: Vendor's comments:

7. What subsequent testing is required because of this failure?

   Subsequent Lot No. No. of snubbers to be tested

8. What corrective action and recurrence controls are to be taken?

Evaluation performed by: ______________________________ Date ___________
Snubber Engineer/SE Designee

Attachment 4
(Page 1 of 1)

Supported System /Component Analysis For Inoperable Snubber

WO No. ________________ Unit __________ Snubber UNID No. ________________

Subgroup No. ____________ PER No. _____________ Mfg./Size ________________

Serial No. ______________ Rated Load __________ Exam No. ________________

1. Describe the condition(s) (e.g., snubber would not activate, was locked up, had excessive drag force, damaged hardware, etc.).

2. Attach the SE evaluation of the attached component:

3. Based on the results of the Engineering evaluation, has the snubber failure mode adversely affected the supported system or component?

Snubber Engineer/SE Designee ___________________________ Date ___________

Attachment 5
(Page 1 of 1)

Case Specific Acceptance Criteria

WO No. ________________ Unit __________ Snubber UNID No. ________________

Subgroup No. ___________ PER No. _____________ Mfg./Size _______________

Serial No. ______________ Rated Load __________ Exam No. _______________

1. Record the parameter(i.e., actuation, bleed, drag) and the test results that are outside the standard acceptance criteria:

2. Specify the case specific Acceptance Criteria and provide justification.

Site Engineering Civil ______________________________ Date ___________

Attachment 6
(Page 1 of 2)

Evaluation of Loose or Missing Attachment Fasteners, or of "As-Found" Stroke Setting Outside of Acceptable Range

This evaluation shall be performed when fasteners, used for attachment of snubber to component, and to snubber anchorage, are discovered loose or missing prior to the As-Found functional testing. This evaluation also shall be performed if the snubber "As-Found setting is outside of the acceptable range specified on design drawing.

W.O. No. __________ Unit _____ Date Discovered ___________

Snubber UNID No. __________ Serial No. ________ Subgroup _________

Exam No. _______ Size _______ Rated Load _______Lbs.

1. Describe the discovered condition and, if possible, determine cause:

Performer: ______________________________ Date ___________

Attachment 6
(Page 2 of 2)

Items 2, 3, and 4 are to be completed by Site Engineering Civil.

2. Evaluate to determine whether the cause may be localized or generic. Use this evaluation to select and list other suspect snubbers for verification, as applicable.

3. Describe the corrective action(s) and provide the As-Found test result.

4. Conclusion: Is the snubber operable? ____ Yes ____ No

   Justification

If "No", notify the Shift Manager or Unit Supervisor immediately. Then complete or request a failure analysis using Attachment 3, and a supported component or system analysis on Attachment 4, as necessary.

Evaluated by: ________________________________ Date __________

Site Engineering Civil

Tennessee Valley Authority
Browns Ferry Nuclear Plant, Unit 2

Relief Request No. 2-ISI-40, Snubbers Inspection and Testing

Relief Request No. 2-ISI-40, Reference I

Browns Ferry Nuclear Plant, Surveillance Instruction, 0-SI-4.6.H-2F, "Functional Testing of Lisega Type 30 Hydraulic Snubbers"

Browns Ferry Nuclear Plant

Unit 0

Surveillance Instruction

0-SI-4.6.H-2F

Functional Testing of Lisega Type 30 Hydraulic Snubbers

Revision 0001

Quality Related

Level of Use: Continuous Use

Effective Date: 09-17-2010

Responsible Organization: DEC, Design Eng Civil

Prepared By: Stephen Samaras

Approved By: Eric J. Frevold

Current Revision Description

Pages Affected: Coversheet, revision description, and pages 31, 32, 33 & 34.

Type of Change: Revision Tracking Number: 002

This revision is to add signoffs and calibration accuracy ranges for M & TE calibrated measurement test equipment and pyrometers as identified by PER 236306. Revised Attachment 2.

Table of Contents

Table of Contents (continued)

1.0 INTRODUCTION

1.1 Purpose

This Surveillance Instruction implements Technical Requirements Manual (TRM) TR 3.7.4, and provides direction for the functional testing of Lisega Type 30 hydraulic snubbers, as given in the Snubber Program Procedure (0-TI-398), on safety related systems.

1.2 Scope

The Lisega Type 30 hydraulic snubbers belong to Subgroup 7.

The portions of Technical Requirements TR 3.7.4 pertaining to visual examination of snubbers are implemented by Surveillance Instructions 2-SI-4.6.H-1, and 3-SI-4.6.H-1.

This Surveillance Instruction (SI) provides the requirements and guidance to perform functional testing of Lisega Type 30 hydraulic snubbers as follows:

- Removal and reinstallation of Lisega Type 30 hydraulic snubbers to facilitate testing is accomplished in accordance with MPI-0-000-SNB004 and recorded in Attachment 2.
- Provides the requirements for functional testing of Lisega Type 30 hydraulic snubbers. This instruction covers subgroup 7 (see Appendix D for snubber subgroup information). To completely fulfill the snubber Technical Requirements Manual (TRM) functional testing requirement Surveillance Instructions, 0-SI-4.6.H-2A, 0-SI-4.6.H-2B, 0-SI-4.6.H-2C, 0-SI-4.6.H-2D and 0-SI-4.6.H-2E must be performed as required per TSR 3.7.4.2.
- Provides a means for the control and documentation of all snubber surveillance activities provided in this Surveillance Instruction.
- This Surveillance Instruction may be used to verify operability of hydraulic snubbers suspected inoperable during performance of the visual examination SI.

1.3 Frequency/Conditions

A. This Surveillance Instruction shall be performed each refueling outage and portions of it may be performed to establish operability in accordance with 2-SI-4.6.H-1 and 3-SI-4.6.H-1, Visual Examination of Hydraulic and Mechanical Snubbers.

B. Snubbers on safety related systems that have experienced unexpected potentially damaging transients shall be edvaluated for the possibility of concealed damage and functionally tested, if applicable.

C. For an inoperable snubber(s), an engineering evaluation must be performed to determine if the component or system restrained by the snubber(s) was adversely affected by inoperability of the snubber(s) during the previous operating cycle and ensure that the restrained component or system remains capable of meeting its design function. The engineering evaluation(s) for supported component or system analysis are to be recorded on Attachment 4.

D. Snubbers removed for maintenance or determined to be inoperable on a non-operable safety related system must be reinstalled or replaced, in accordance with MPI-0-000-SNB004 and tested in accordance with this instruction, prior to declaring the system operable.

E. New, replaced or rebuilt snubber(s) shall meet the functional test acceptance criteria before their installation in the unit and must have been functionally tested "Satisfactory", within 12 months prior to their installation.

2.0 REFERENCES

A. Technical Requirements Manual TR 3.7.4, Snubbers.

B. 2-SI-4.6.H-1, Surveillance Instruction Visual Examination of Hydraulic and Mechanical Snubbers.

C. 3-SI-4.6.H-1, Surveillance Instruction Visual Examination of Hydraulic and Mechanical Snubbers.

D. MPI-0-000-SNB002, Hydraulic Shock and Sway Arrestor Bergen-Paterson, Anchor/Darling and Fronek Unit Disaasembly and Reassembly

E. MPI-0-000-SNB004, Instructions for Removing and Reinstalling Pacific Scientific Mechanical, Bergen-Paterson, Grinnell, Lisega Type 30 Hydraulic and Torus Dynamic Restraint Snubbers.

F. BFN-VTD-L329-0110, Field Test Procedure for Lisega Type 30 Hydraulic Snubbers.

G. BFN- VTD-L329-0095, Technical Specifications for Design of Lisega Standard Supports

H. 0-TI-398, Snubber Program Procedure

I. SPP-3.1, Corrective Action Program

J. SPP-8.1, Conduct of Testing.

3.0 PRECAUTIONS AND LIMITATIONS

None

4.0 PREREQUISITES

None

5.0 SPECIAL TOOLS AND EQUIPMENT RECOMMENDED

None

6.0 ACCEPTANCE CRITERIA

A. Responses which fail to meet the following As-Found functional test acceptance criteria require immediate notification of the Shift Manager or Unit Supervisor at the time of failure.

B. The snubber functional test shall verify that:

1. " As-Found"

   a. Activation shall occur in both directions of travel at lockup velocity greater than or equal 4.72 inches/minute and less than or equal 14.17 inches/minute.

   b. Bleed rate shall take place after activation in tension and compression direction and shall be between 0.47 inch/minute and 4.72 inches/minute at full rated load plus/minus 5 percent.

2. "As- Left"

   a. Activation shall occur in both directions of travel at lockup velocity greater than or equal 4.72 inches/minute and less than or equal 14.17 inches/minute.

   b. Bleed rate shall take place after activation in tension and compression direction and shall be between 0.47 inch/minute and 4.72 inches/minute at full rated load plus/minus 5 percent.

   c. Drag force shall be less than or equal 2.0 percent of rated load of the snubber, or 20 lbs. (whichever is greater).

Above parameters are based on ambient temperature between 65 and 75 degrees F.

REFER TO Appendix A for Lock Up Rate Temperature Correction Factor, and **REFER TO** Appendix B for Bleed Rate Temperature Correction Factors for temperatures above 75 degrees F. These values are based on forces equivalent to full rated load.

REFER TO Appendix C in calculating the base Bleed values at loads other than full load, **THEN** use Appendix B to correct for temperature. Bleed value at any load from 25 to 120 percent shall fall between the lowest and highest plots shown (0.47 inch/minute and 4.72 inch/minute plots).

C. The stroke setting, adjusted for pipe temperature other than ambient if necessary, shall be within the limits shown on the design drawing. Otherwise, complete Attachment 5.

6.0 ACCEPTANCE CRITERIA (continued)

D. There shall be no loose or missing fasteners for attachment of the As-Found Lisega Type 30 hydraulic snubber(s) to the component or the anchorage. Otherwise, complete Attachment 5.

E. **NOT** meeting acceptance criteria for the stroke setting, or loose or missing fasteners, does **NOT** require testing an additional lot equal to 10% of the subgroup of snubbers. Evaluation of snubber operability, corrective actions, and selection of other suspect snubbers for verification shall be as specified on Attachment 3 or Attachment 5, as applicable.

7.0 PROCEDURE STEPS

7.1 Training and Qualification of Performers

A. A thorough briefing should be conducted on SI performance prior to starting.

B. The cognizant individual or Snubber Engineer responsible for the performance of the Surveillance Instruction must be qualified as a test director.

C. Appropriate General Employee Training (GET) (including respirator training) should be received by test personnel prior to performing this SI.

D. Training required for the testing of hydraulic snubbers shall meet the requirements of Task Number MMY 510.

7.2 Preparation of Test Data Package

[1] **EXCLUDE** the snubbers from the initial test lot (sample plan) which are scheduled for deletion, in accordance with approved Design Change Notices.

[2] **EXCLUDE** the snubbers until the next outage from the initial test lot (sample plan) which are to be added, in accordance with approved Design Change Notices.

[3] **SELECT** snubbers for retest which were placed in the same location as snubbers which failed during the previous outage, if the failure analysis showed that the failure was due to the location. However, these snubbers shall be tested in addition to the initial 10 percent test lot (sample plan).

7.2 Preparation of Test Data Package (continued)

[4] **DETERMINE** the initial test lot (sample plan) as follows:

- **SELECT** 10 percent of the snubbers from Subgroup 7 (**SEE** Appendix D).
- In general, **SELECT** the snubbers with the most time from the previous test.
- Sample should be weighed to include more snubbers from severe service areas (i.e. inside the drywell).
- **SELECT** snubbers of various sizes.

[5] **REVIEW** the applicable hanger drawings to verify the location and any conditions that will require special preparation or equipment.

[6] **REQUEST** scaffold or similar devices to be built or available, as needed.

[7] **RECORD** the required information on Attachment 1, and prior to REMOVAL of a snubber per MPI-0-000-SNB004 for functional test, **RECORD** the "As-Found" Stroke Setting in Attachment 2.

7.3 "As-Found or As-Left" Functional Test Using the STB-200 Test Bench

[1] **IF** the extension or one of the end attachments has been removed, **THEN**

INSTALL the appropriate end attachments located in the snubber test facility.

[2] **ENSURE** the test bench has been warmed up in accordance with Appendix E of this procedure.

NOTE
The following describes a suggested procedure for "Testing a Snubber" using the STB 200 Snubber Test Bench with the upgraded Windows Software Operations Manual.

[3] POWERING UP THE TEST SYSTEM

TURN ON the master power switch on the control console. Make sure that the computer, monitor, and printer are turned on. **TURN ON** the main breaker on the Hydraulic Power Unit (HPU) located at the end of the power unit. **ENSURE** that all emergency stop buttons are pulled out.

7.3 "As-Found or As-Left" Functional Test Using the STB-200 Test Bench (continued)

[4] STARTING THE SOFTWARE

Once the computer has "Booted Up", the Windows Desktop will be displayed. **SELECT** the "STB 200" icon and **DOUBLE CLICK** on it, this will Start the Test program. The "LOG ON" prompt window will appear. **ENTER** your user name and password in either upper or lower case letters. All functions required by the system are available in the screen, or from one of the Pull Down Menus at the top of the screen.

[5] DAILY CALIBRATION CHECK

PERFORM the Daily Calibration Check using Appendix E and **SIGN** the daily calibration form. After Daily Calibration Check has been completed, and the Daily Calibration Report is "Satisfactory", **PROCEED** on testing a snubber.

[6] A surface contact pyrometer may be used to obtain the surface temperature of the snubber, and **RECORD** on Attachment 2 as appropriate the temperature correction from Appendix A, B or C,for the surface temperature obtained.

[7] TESTING A SNUBBER

[7.1] **PICK** the Snubber Type

USING the Snubber Pull Down List in the User Supplied Information block, **SELECT** the Type Snubber to be tested.

[7.2] **ENTER** the Header Information

FILL in the other information as indicated in the User Supplied Information block.

7.3 "As-Found or As-Left" Functional Test Using the STB-200 Test Bench (continued)

[7.3] Running the Test

[7.3.1] **PICK** the Test

CLICK on the Type of Test (i.e., "As-Left" or "As-Found") desired.

[7.3.2] **START** the Test

CLICK on the Start Test button. If this is the first test performed on the snubber, the following two windows will appear:

[7.3.3] Tare weight Window

This window allows the User to "zero out" any offset load that the load cell may be reading. This should be performed BEFORE installing the snubber in the test bench. **WAIT** for the "Raw Reading" to settle (as far as possible), and then **CLICK** "Adjust Load Cell". The "Adjustment" will be updated, and the "Adjusted Reading" should now read close to zero (0) lb. The "Adjust Load Cell" button may be Clicked again if a new adjustment value is desired.

Once the readings are as desired, **CLICK** the "Continue" button. **ENSURE** the correct load cell is connected to the machine. **CHOOSE** the proper bushings and pins for the snubber being tested, then **INSTALL** the bushings in both clevis attachments on the machine.

7.3 "As-Found or As-Left" Functional Test Using the STB-200 Test Bench (continued)

[7.3.4] Stroke and Position Window

INSTALL the snubber in the test bench, with the piston or operable end toward the drive piston of the machine if possible. **ADJUST** the backstop and or use the Jog Speed Slider to adjust the bench and the driver cylinder to the desired pin to pin dimension. The jog slider adjusts the jog speed. The joystick on the test frame controls the actual motion of the driver. **INSTALL** the pins through the bushing and the snubber spherical bearings.

ONCE the snubber has been pinned for a test, the snubber's piston position (distance from fully retracted position) should be accurately measured (within 0.1 inch) and entered in the SNUBBER EXTENSION window.

If the test program calculates that it cannot fully extend or fully retract the snubber during drag testing, one or more of the text windows on the screen will be highlighted in red. If this happens, the backstop will have to be adjusted and the snubber extension recalculated. The program calculates whether it can fully test the snubber through its stroke range. It will display the two ends of stroke (minus a 1/2 inch safety zones), the calculated center position and the bottomed out position for the snubber.

Once the data has been successfully entered, **TIGHTEN** the lock nuts on the load cell threaded rod snug tight to prevent slippage during the test.

ENTER the snubber UNID number, WO number, system number, serial number, and the test equipment information on Attachment 2 as required, and **CLICK** on “Continue with Test” to continue the test.

7.3 "As-Found or As-Left" Functional Test Using the STB-200 Test Bench (continued)

[7.3.5] If an Activation Test is Selected

After all the above steps has been completed, and PRIOR to starting an "As-Left" or "As-Found" Activation Test, the test program will initiate a routine to set and stabilize the hydraulic system pressure at a calculated level sufficient to achieve the requested test load. During this period, the setpoint and actual pressures are displayed, along with the output voltage, and a "count down" value. When the pressure is near the desired value, the countdown value will decrement towards zero. If the pressure fluctuates out of limits, the countdown will reset to six. Once the pressure is stable enough to let the countdown complete, the test will begin automatically.

OBSERVE that the snubber activates in both directions, to establish operability of the snubber in the "As-Left" or "As-Found" condition.

VERIFY that the corrected lockup velocity is between 4.72 inch/minute and 14.17 inches/minute.

VERIFY that the corrected bleed rate is between 0.47 inch/minute and 4.72 inch/minute.

RECORD all necessary information on Attachment 2, as appropriate.

If the user wishes to force a test, clicking the "Force the Test" button will initiate the test regardless of pressure.

NOTE
Forcing a test may allow the machine to overstress the snubber during the test!

Clicking the "Abort the Test" button will cause the test cycle to abort without performing the test.

7.3 "As-Found or As-Left" Functional Test Using the STB-200 Test Bench (continued)

[7.3.6] If Drag Test is Selected

If a Drag Test (i.e., ID, AC, and FD test sequence for "As-Left", and AC, FD test sequence for "As-Found" test) is selected, the test system will automatically begin the drag test. The system will determine the starting position of the snubber, and choose the initial test direction to move towards the farthest end of stroke. The drag speed will be automatically controlled to the target speed set earlier. This test is to VERIFY free travel of the piston rod through its full stroke. The Raw Test Data graphed in real time is reviewed to:

VERIFY that the drag force of the snubber is less than or equal to 2% of rated load of the snubber, or 20 pounds (whichever is greater).

RECORD this information on Attachment 2, as appropriate.

[7.3.7] Printing the Results

After the test is complete, the calculations appropriate to that test are performed and the results are displayed on the screen. This allows the user to review and determine if the "As-Left" or "As-Found" test results meet the acceptance criteria, and plot the test results:

CLICK on the "Print Test" button to open the standard Windows printer dialog box. **SELECT** the proper printer, and **CLICK** "OK" to start the printing.

ATTACH the Printed Results in Attachment 2, as part of the work package.

7.3 "As-Found or As-Left" Functional Test Using the STB-200 Test Bench (continued)

[7.3.8] Saving the Test Results

To save a test file to disk, **CLICK** the "Save Test" button. This saves the test results in the "test_data" directory. The file name of the saved test result is as follows:

Work_Order_number Serial_number Test_Date Test_Type.csv

Where:

Work_Order_number is the value entered in the work order number entry
Serial_number is the value entered in the serial number entry
Test_Date is the date when test was performed
Test_Type is **ID_**for initial drag tests, **AC** for activation tests and **FD** for final drag tests.
Tests are saved as comma separated variable files and may be directly loaded into Excel or similar spreadsheet programs as desired.

[7.3.9] Testing Another Snubber

SELECT a new snubber type, if necessary, from the snubber pull down list. The results of the last test will be erased, and the graph will rescale for the test to be done. If a snubber of the same type is to be tested, the user has to only change the serial number, hanger number, and work order entries.

REPEAT this procedure from Step 7.3[7.3.1] to **COMPLETE** Testing Another Snubber.

[7.4] Quitting and Shutting Down the System

TURN OFF the 480Vac power on the HPU. On the computer screen, **SELECT** EXIT from the File Menu. **WHEN** the Windows screen appears, **CLICK** on START, **THEN SHUTDOWN**, and **CLICK** on SHUT DOWN the Computer. THEN **CLICK** OK.

WHEN the computer has completely shutdown, **TURN OFF** the main power switch on the current control consoles.

7.3 "As-Found or As-Left" Functional Test Using the STB-200 Test Bench (continued)

REMINDER

Do **NOT** shutdown the console power without exiting Windows properly.

NOTE

At this time the machine has completed Running the Test. Unless you are leaving the building, leave the machine running so it will **NOT** have to be warmed up to perform another test (i.e., the "As-Left" or "As-Found" test)as needed.

[8] **ENTER** the information on Attachment 2, as appropriate.

[9] **DETERMINE** if the "As-Found" test results meet the acceptance criteria in Section 6.0B.1.

[10] **IF** the "As-Found" test results are within the acceptable range in Section 6.0B.2 for the "As-Left", **THEN**

PREPARE the snubber for reinstallation.

[11] **IF** the "As-Left" test results are within the acceptance range in Section 6.0B.2, **THEN**

PREPARE the snubber for installation. OTHERWISE, do **NOT** install snubber in the plant.

7.3 "As-Found or As-Left" Functional Test Using the STB-200 Test Bench (continued)

[12] **IF** a snubber tested in the "As-Found" condition fails to meet the acceptance criteria, **PERFORM** the following:

- **NOTIFY** the Shift Manager or Unit Supervisor immediately.
- **REQUEST** a failure analysis using Attachment 3, and a supported component or system analysis on Attachment 4, as necessary.
- **DETERMINE** the subsequent test lot (sample plan), as required
- **SELECT** the number of snubbers equal to 10 percent of the remaining snubbers in that subgroup.
- In general, **SELECT** the snubbers with most time from the previous test.
- **FILL OUT** the applicable sections of Attachment 2, as required.
- **ENSURE** test data package is ready for Shift Manager/Unit Supervisor Authorization.
- **PERFORM** applicable functional test for the subsequent test lot (sample plan). Selection of subsequent test lots and corresponding testing shall continue until no failure is found, or until all the snubbers in the subgroup have been tested.

7.4 Results Evaluation

NOTE

The following reviews are performed by the Snubber Engineer/SE Designee or a representative of Site Engineering Civil:

[1] **REVIEW** all of the test data on Attachment 2, as applicable.

[2] **IF** any snubber is determined INOPERABLE in the As-Found condition:

- **ENSURE** that the Shift Manager/Unit Supervisor has been notified of the inoperable snubber.
- **ENSURE** that a PER has been initiated in accordance with SPP-8.1 and SPP-3.1.
- **INITIATE** a Work Order (WO) to replace the snubber, if necessary.
- **PERFORM** a failure analysis of any inoperable snubber(s) and **DOCUMENT** on Attachment 3.
- **PERFORM** the supported system or component analysis on Attachment 4.
- **SELECT** subsequent test lot, as required for a functional test failure, or other snubbers for verification, as specified on Attachment 5.

7.5 Data Sheet Review

[1] **VERIFY** that all necessary attachments are included.

[2] **REVIEW** the completed SI package for final acceptance.

NOTE

Computer generated data sheets containing information regarding the initial test lot, subsequent test lots, rebuild, etc., should be submitted with the SI data package.

[3] **SUBMIT** the completed package for closure.

8.0 ILLUSTRATIONS/ATTACHMENTS

A. Illustration 1 - Stroke Position Measurement

B. Appendix A - Lock Up Rate Temperature Correction Chart

C. Appendix B - Bleed Rate Temperature Correction Chart

D. Appendix C - Bleed Rate vs. Load Correction Chart

E. Appendix D - Subgrouping of Snubbers

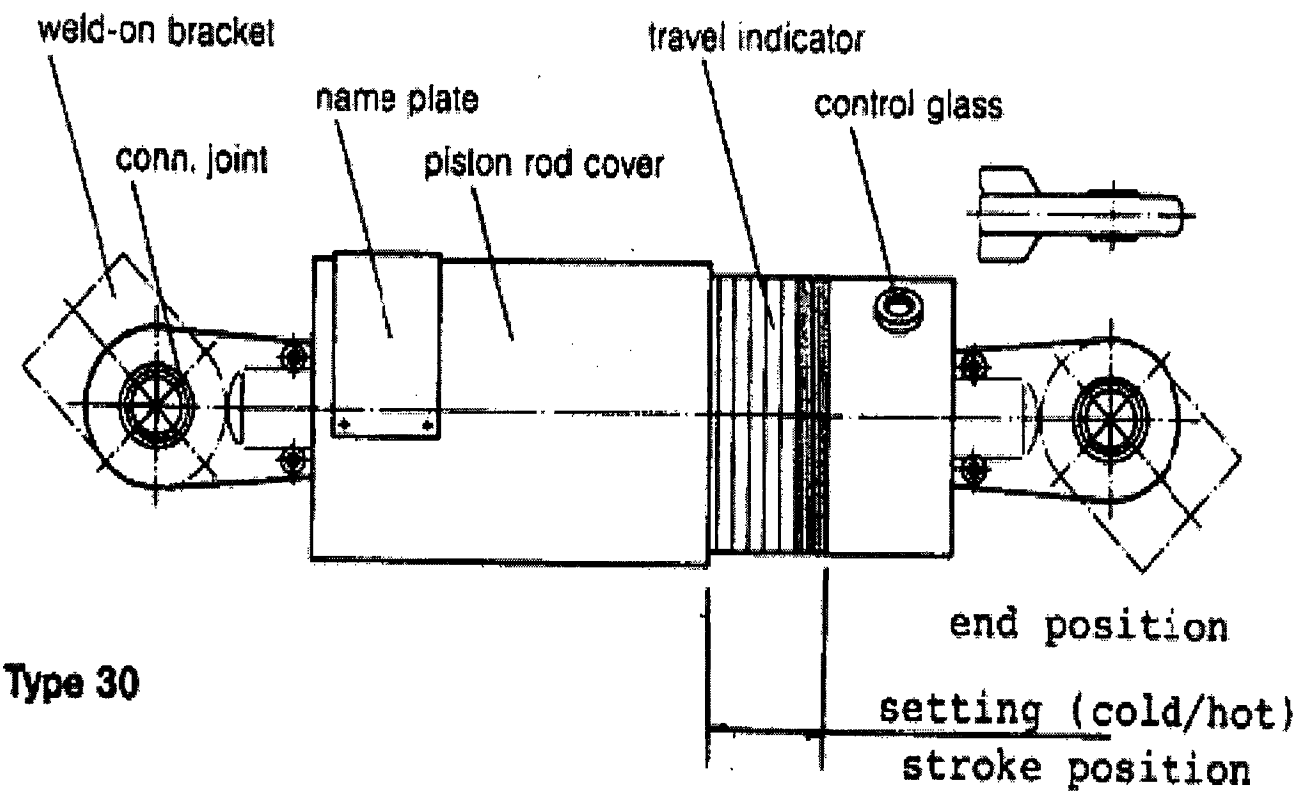
F. Appendix E - Daily Startup Procedure for the STB-200 Test Bench

G. Appendix F - Common Modes of Snubber Failure and Possible Causes

Attachment 1	-	*Surveillance Instruction Review Form*
Attachment 2	-	As-Found and As-Left Test Data, Removal and Reinstallation Data Sheets for Lisega Type 30 Hydraulic Snubber
Attachment 3	-	Engineering Failure Analysis for Inoperable Snubber
Attachment 4	-	Supported System/Component Analysis for Inoperable Snubber
Attachment 5	-	Evaluation of Loose or Missing Attachment Fasteners or of "As-Found" Stroke Setting Otuside of Acceptable Range

Illustration 1
(Page 1 of 1)

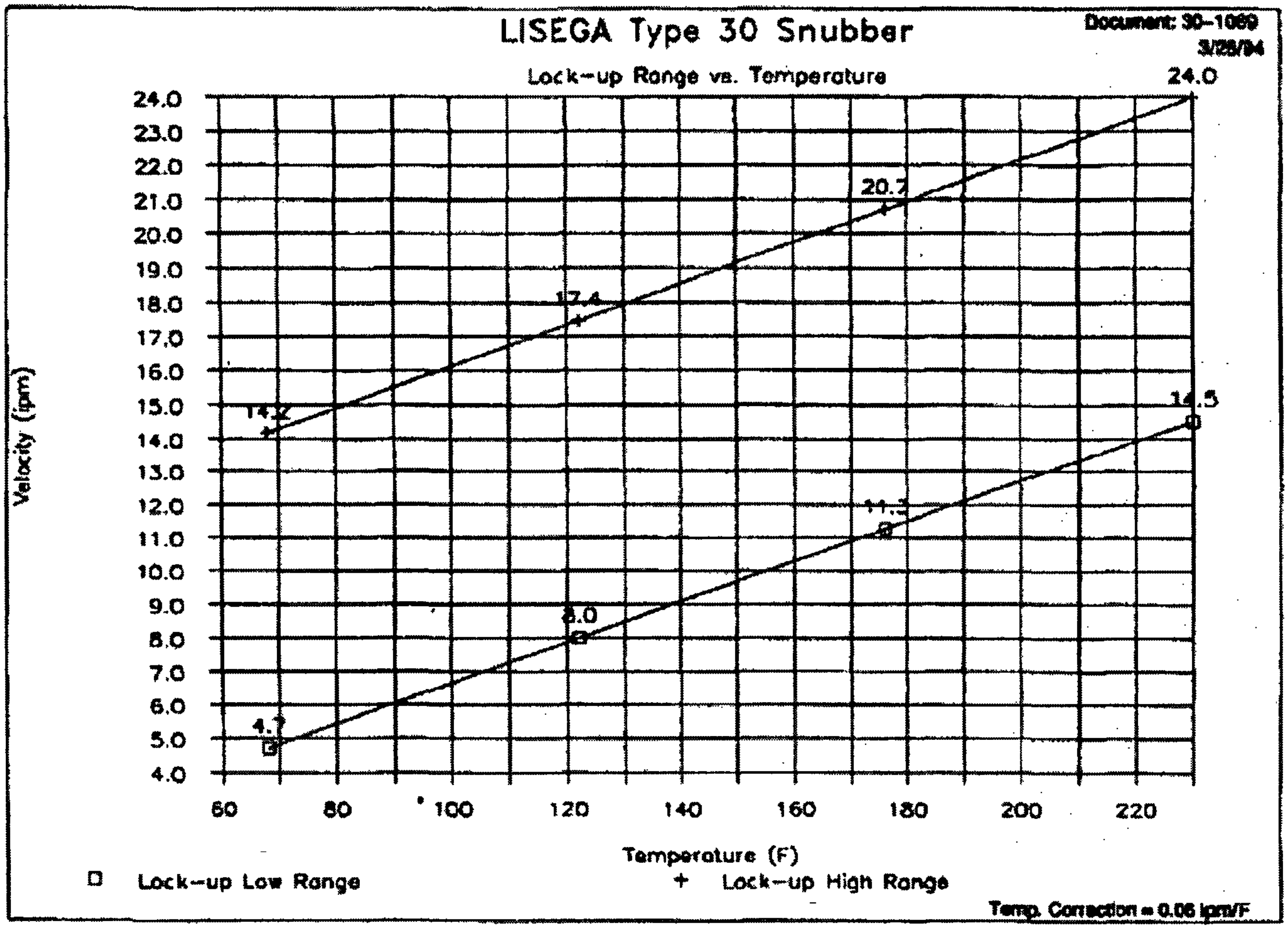
Stroke Position Measurement



Type 30

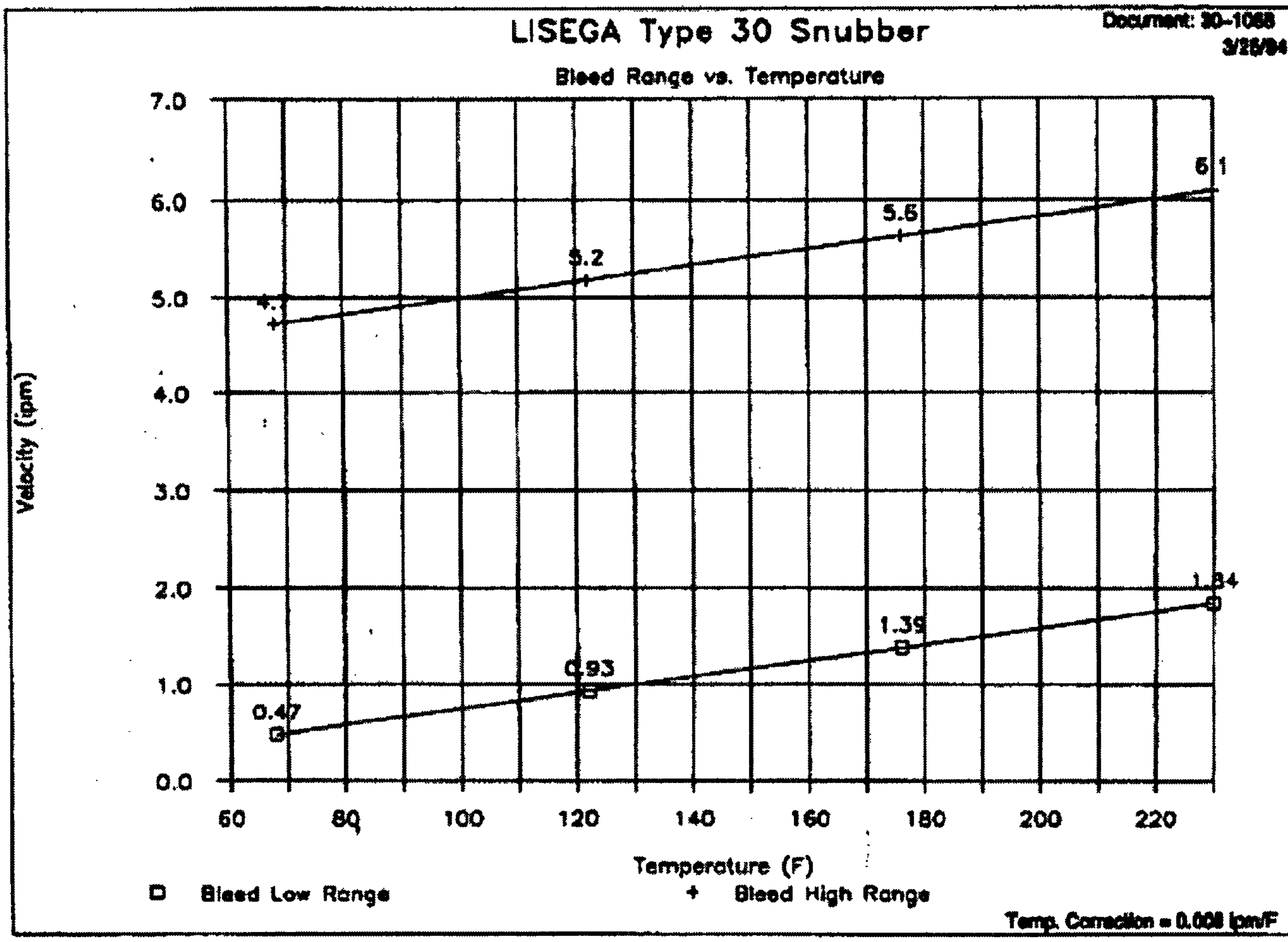
Appendix A
(Page 1 of 1)

Lock Up Rate Temperature Correction Chart



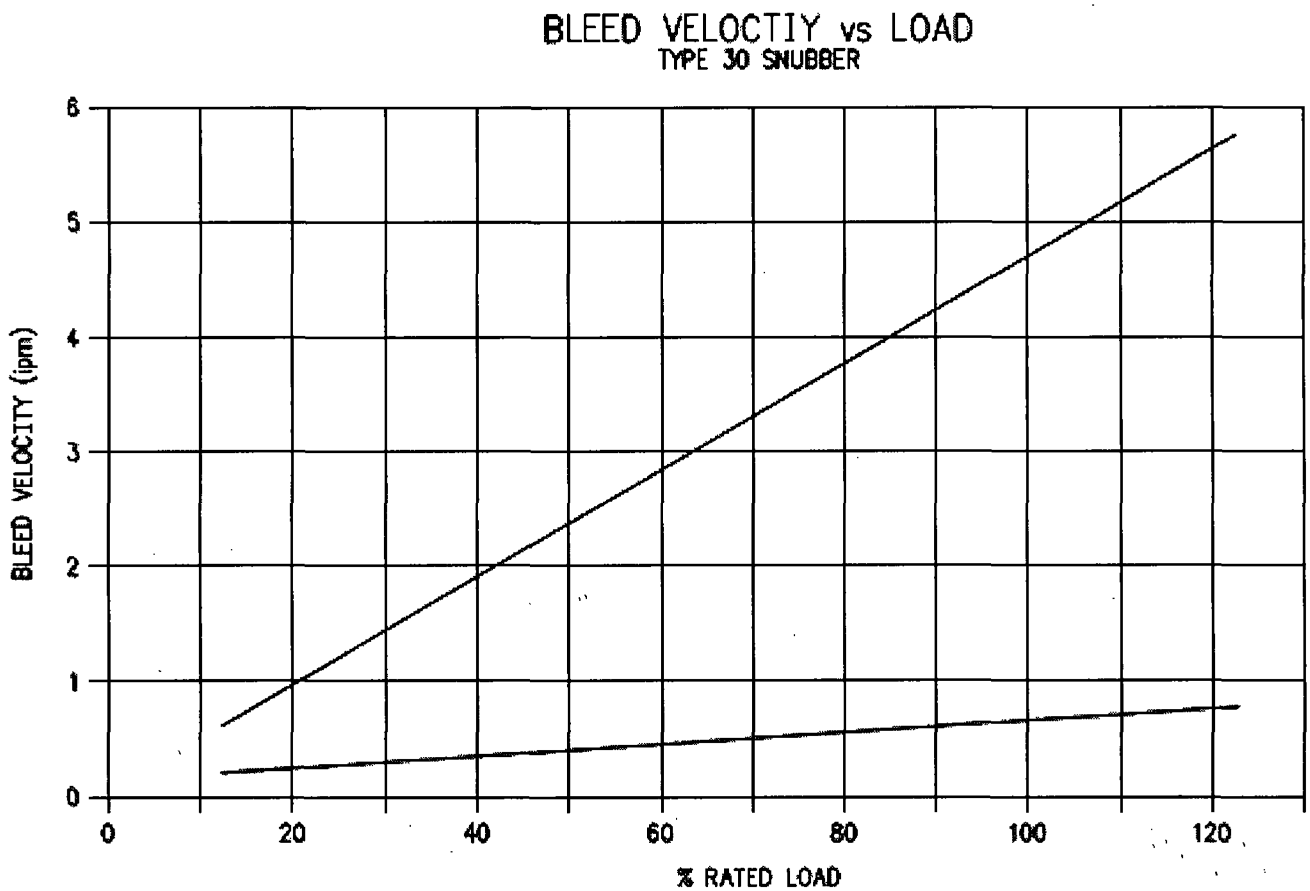
Appendix B
(Page 1 of 1)

Bleed Rate Temperature Correction Chart



Appendix C
(Page 1 of 1)

Bleed Rate vs. Load Correction Chart



Appendix D
(Page 1 of 1)

Subgrouping of Snubbers

1.0 SUBGROUPING:

For functional testing, the Lisega Type 30 hydraulic snubbers, belong to one subgroup as described below:

Subgroup 7; All sizes of Lisega Type 30 hydraulic snubbers.

Appendix E
(Page 1 of 3)

Daily Startup Procedure for the STB-200 Test Bench

1.0 DAILY STARTUP PROCEDURE

[1] **WARM-UP**

EXCERCISE both benches (i.e., small and large) by selecting the Manual Control Panel function from the Tool Menu. **CLICK** on "Auto Exercise" in the Operating Mode block will cause the selected bench to automatically stroke back and forth. The system should be run this way until the oil temperature is above approximately 70°F or smooth operation is attained. Both test b benches should be exercised. To change from one bench to the other, **CLICK** on the bench label.

[2] **CHECK THE PRESSURE TRANSMITTER**

NOTE
This instrument does NOT provide safety-related data. This check is optional.

In the Manual Control Panel mode, **SELECT** Manual in the Operating Mode block. **TURN** the "HP Pump" on, Then **USE** the HP Pump slider to raise the pressure command setting until the "Pressure" reading is approximately 2000 psi. **CHECK** the 0-3000 psi gauge in the front of the HPU. The two readings should be within ~ 200 psi.

[3] **PARK THE RAM**

SELECT the "Park the Ram" to prepare the bench for the Daily Calibration Check.

This should be done for both benches.

[4] **SHUT DOWN THE MANUAL CONTROL PANEL**

CLICK on "SHUT DOWN" to exit the Manual Control Panel.

Appendix E
(Page 2 of 3)

Daily Startup Procedure for the STB-200 Test Bench

2.0 STATUS CHECK

[1] During the warm-up period, the frame drive cylinders should be stroked using the proportional valve and/or the jog/drag valve.

[2] The system should be checked for loose fittings, bolts, etc.

[3] The filter indicators should be watched during cylinder stroking to insure that they are **NOT** illuminating.

[4] If the indicators are illuminating the filters should be changed before continuing with operation of the machine or any testing.

3.0 DAILY CALIBRATION CHECKS

The following calibration checks assure the functionality of the instrument and Data Acquisition and control System (DAS) for testing. They do **NOT** take the place of full system calibrations which must be performed on a periodic basis.

The instrument system (DAS system and transmitters) should be powered up to 30 minutes before any checks or testing is performed.

Prior to performing this function, both rams should have been "Parked" using the "Park the Ram" function in the Manual Control Panel.

[1] **SELECT THE DAILY CALIBRATION FUNCTION**

SELECT the Daily Calibration Check function.

[2] **CONNECT THE LOW RANGE LOAD CELL AS DIRECTED**

If directed to by the software, **ELECTRICALLY CONNECT** the Low Range Load Cell as instructed. The load cell does **NOT** need to be mechanically mounted in the test bench, but it must be connected to its electrical cable.

[3] **STORE THE "ZERO" CALIBRATION READINGS**

For each instrument **CLICK** the "STORE" button in the "ZERO" column on the Daily Calibration screen for that instrument. The zero reading will be captured in the "Actual" "Zero" column. If it is within limits, the box will turn gray. If it is **NOT** within limits, the box will turn yellow.

Appendix E
(Page 3 of 3)

Daily Startup Procedure for the STB-200 Test Bench

3.0 DAILY CALIBRATION CHECKS (continued)

[4] **STORE THE "SPAN" CALIBRATION READINGS**

For each instrument, **PRESS** in the "CAL" button on the front of the instrument, then **CLICK** the "STORE" button in the "SPAN" column on the Daily Calibration screen for that instrument. The span reading will be captured in the "ACTUAL" "SPAN" column. If it is within limits, the box will turn gray. If it is **NOT** within limits, the box will turn yellow.

[5] **PRINT THE REPORT**

When all readings for both benches have been stored, **CLICK** on the "PRINT" button to print the Daily Calibration Report. **IF** the report is "SATISFACTORY", **CONTINUE** the testing. **IF** the report is "UNSATISFACTORY", **HALT** and **CORRECT** the problem before continuing.

Appendix F
(Page 1 of 1)

Common Modes of Snubber Failure and Possible Causes

TYPE	COMMON MODES OF FAILURE	POSSIBLE CAUSE
HYDRAULIC	No Lockup	Wrong Size Poppet Wrong Size Poppet Spring Poppet Frozen or Blocked Open Excessively low or No Fluid Lockup Adjustment Set Improperly Damaged Piston Rod Seal Damaged "0" Ring
	High Lockup	Wrong Size Poppet Wrong Size Poppet Spring Lockup Velocity Adjustment Set Improperly Damaged "0" Ring
	Low Lockup	Broken Poppet Spring Poppet Frozen or Blocked Closed Lockup velocity Adjustment Set Improperly Foreign Objects in Fluid
	High Bleed	Defective or Damaged Poppet Defective or Damaged Poppet Seat Wrong Size Poppet Bleed Adjustment Set Improperly Damaged "O" Ring
	No Bleed	Foreign Objects in Fluid Bleed Adjustment Set Improperly
	Miscellaneous	Hardware Improper Installation Improper Handling or Abuse Misapplication Overload Vibration or Wear

Attachment 1
(Page 1 of 1)

Surveillance Instruction Review Form

REASON FOR TEST:
☐ Scheduled Surveillance UNIT MODE ________________
☐ System Inoperable (Explain in Remarks)
☐ Maintenance (WO No. ______________)
☐ Other (Explain in Remarks)

WO NO. ____________________ SNUBBER UNID ______________ SERIAL NO. ______________

PRE-TEST REMARKS: ____

____

____

PERFORMED BY:

Initials	Name (Print)	Name (Signature)

NOTE: The following entries for contacting Shift Manager/Unit Supervisor shall be marked N/A if the snubber is NOT Inoperable.

NOTIFY Shift Manager/Unit Supervisor when snubber found Inoperable. _________

SM/UNIT SUPERVISOR CONTACTED ____________ Date __________ Time _________

NOTIFY Shift Manager/Unit Supervisor when snubber Operability is restored.

SM/UNIT SUPERVISOR CONTACTED ____________ Date __________ Time _________

MECHANICAL MAINTENANCE REVIEWER ________________ Date ______________

Signature attests that I understand the scope and purpose of this instruction and that, to the best of my knowledge, it was properly performed in accordance with instruction in that: the recording, reduction, and evaluation of data is complete and correct; acceptance criteria is met or justification for exceptions is provided; portions of test performed were appropriate for specified test conditions or reasons for test; deficiencies were evaluated and dispositioned; reportability was evaluated; marginal results were evaluated with respect to potential for future problems based on operating experience and regulatory requirements; and instruction was complete except as noted in post-test remarks.

SNUBBER ENGINEER/SITE ENGINEERING CIVIL REVIEWER ____________________ Date ______________

SCHEDULING COORDINATOR ____________________ Date ______________

POST-TEST REMARKS: ____

____

Attachment 2
(Page 1 of 4)

As-Found and As-Left Test Data, Removal and Reinstallation Data Sheets for Lisega Type 30 Hydraulic Snubber

AS-FOUND LISEGA TYPE 30 HYDRAULIC SNUBBER TEST DATA

WO No. ____________________ Date: ____________

Snubber UNID: ____________________ Pyrometer Number: ____________

Serial Number: ____________________ Calibration Due Date: ____________

Exam Number: ____________________

Snubber Rated Load: ____________________ (Calibration Accuracy ± 2° F)

Temperature/Correction: ____________

	Activation (in/min)	Temp Correction (in/min)	Corrected Activation (in/min)	Generic Acceptance Criteria	Performer Initials/Date
Tension Compression	______ ______	______ ______	______ ______	4.72 in/min ≤ Corrected Activation ≤ 14.17 in/min	Initials______ Date_____(AC)
	Bleed (in/min)	Temp Correction (in/min)	Corrected Bleed (in/min)		
Tension Compression	______ ______	______ ______	______ ______	0.47 in/min ≤ Corrected Bleed ≤ 4.72 in/min	Initials______ Date_____(AC)
Copy of the plotted As-Found test results is attached to this data sheet.					____ ____ Initials / Date

Snubber meets Acceptance Criteria: ____Yes ____No ____ ____ Initials / Date

If the acceptance criteria has NOT been met, Notify the Shift Manager or Unit Supervisor immediately.

______________________________ ____________

SNUBBER ENGINEER/SE DESIGNEE Date

Attachment 2
(Page 2 of 4)

AS-LEFT LISEGA TYPE 30 HYDRAULIC SNUBBER TEST DATA

WO No. ____________ Date: ____________
Snubber UNID: ____________ Pyrometer Number: ____________
Serial Number: ____________ Calibration Due Date: ____________
Exam Number: ____________
Snubber Rated Load: ____________ (Calibration Accuracy ± 2° F)
Temperature/Correction: ____________

	Activation (in/min)	Temp Correction (in/min)	Corrected Activation (in/min)	Generic Acceptance Criteria	Performer Initials/Date
Tension Compression	______ ______	______ ______	______ ______	4.72 in/min ≤ Corrected Activation ≤ 14.17 in/min	Initials______ Date_____(AC)
	Bleed (in/min)	Temp Correction (in/min)	Corrected Bleed (in/min)		
Tension Compression	______ ______	______ ______	______ ______	0.47 in/min ≤ Corrected Bleed ≤ 4.72 in/min	Initials______ Date_____(AC)
	Drag(lbs)				
Tension Max: Compression Max:	______ ______	N/A N/A	N/A N/A	Does NOT exceed 2% of snubber rated load Rated Load x 0.02 =______lbs., or 20 lbs. (whichever is greater)	Initials______ Date_____(AC)
Copy of the plotted As-Left test results is attached to this data sheet.					____ ____ Initials / Date

Snubber meets Acceptance Criteria: ____Yes ____No ____ ____ Initials / Date

____________________ ____________
SNUBBER ENGINEER/SE DESIGNEE Date

Attachment 2
(Page 3 of 4)

REMOVAL AND REINSTALLATION OF LISEGA TYPE 30 HYDRAULIC SNUBBER

WO No. ______________ Unit _____ Snubber UNID No. ______________________

Serial No. ________ Subgroup ______ Test Lot: Initial _____ Subsequent _____

Exam No. ________ Size ______ Rated Load ________ lbs.

Design drawing number _________________________

Shift Manager/Unit Supervisor and Snubber Engineer/SE Designee notified prior to removal of snubber for functional testing.

____________________	_____________	_____________
Foreman/Designee	Date	Time

As-Found Stroke Setting _________

(Equals Stroke Position measurement. **REFER TO** ILLUSTRATION 1.)

Required Stroke Setting Range ____________

(from Design drawing)

Pipe Temp.: _____ °F, If other than ambient (per 0-47B435-5F, Note 24), notify Snubber Engineer/Site Engineering Civil.

Pyrometer No.: ________________ Calibration Due Date: ____________

(Calibration Accuracy ± 2° F)

The As-Found Stroke Setting is within the acceptable limits shown in the design drawing listed above. If the answer is "No", initiate Attachment 5.

______ Yes _______ No ___________________ _________ (AC)
Performer Signature Date

All fasteners for the As-Found snubber are secured and acceptable (i.e., no loose or missing fasteners on the component or anchorage).
If the answer to the above is "No", intiate Attachment 5.

______ Yes _______ No ___________________ _________ (AC)
Performer Signature Date

Attachment 2
(Page 4 of 4)

REMOVAL AND REINSTALLATION OF LISEGA TYPE 30 HYDRAULIC SNUBBERS

WO No. ________________ Unit _________ Snubber UNID No. ________________

Snubber reinstallation:

Same snubber reinstalled	_____ Yes	_____ No	
If No, enter snubber serial number	Serial Number ____________		
Snubber is reinstalled in proper location	_____ Yes	_____ No	
All locking devices are secured	_____ Yes	_____ No	
Cotter pins are spread	_____ Yes	_____ No	_____ **N/A**
Spherical bearing greased	_____ Yes	_____ No	_____ **N/A**
Gaps between spacers and spherical bearing are 1/16 inch each side, 1/8 inch total or less	_____ Yes	_____ No	
Snubber is tagged	_____ Yes	_____ No	
Bolts and jam nuts torqued	_____ Yes	_____ No	_____ **N/A**
Anti-seize compound applied, as needed	_____ Yes	_____ No	_____ **N/A**

As-Left Stroke Setting ____________

See Attachment 4 of MPI-0-000-SNB004 for Torque Wrench Documentation

________________________ ____________
Performer Signature Date

The As-Left Stroke Setting is within the acceptable limits shown in the Design Drawing.

_____ Yes _____ No ________________________ ____________
Performer Signature Date

SHIFT MANAGER/UNIT SUPERVISOR notified of operable and reinstalled snubber.

________________________ ____________ (AC)
Foreman/Designee Date

Remarks: ____

____

Attachment 3
(Page 1 of 2)

Engineering Failure Analysis for Inoperable Snubber

WO No. ________________ Unit _______ Snubber UNID No. ______________

Subgroup No. _________ PER No. ______________ Mfg./Size ________________

Serial No. ____________ Rated Load ____________ Exam No. ________ Lot _______

1. Identify the mode of failure(s):

   ☐ High activation velocity ☐ Low Activation velocity ☐ High bleed rate
   ☐ Low bleed rate ☐ Other

   Explain (if necessary)

2. Describe the conditions of the failure:

3. Determine the cause of failure, using Appendix F for the possible causes (disassembly of the snubber may be necessary):

4. For a snubber that does **NOT** activate, release, is locked up, or damaged hardware, was the cause of the failure a design or manufacturing defect?
   ☐ Yes ☐ No

   Explain Evaluation:

Attachment 3
(Page 2 of 2)

Engineering Failure Analysis for Inoperable Snubber

WO No. ______________ Unit ______ Snubber UNID No. ____________

Subgroup No. ________ PER No. ____________ Mfg./Size ______________

Serial No. ________ Rated Load __________ Exam No. _______ Lot ______

5. Snubber Failure classified as: ☐ Location ☐ Manufacturing ☐ Design
   ☐ Unknown ☐ Other

6. Does the vendor need to be contacted? ☐ Yes ☐ No
   Vendor Name:
   Person contacted:
   Date:
   Vendor's comments:

7. What subsequent testing is required because of this failure?

   Subsequent Lot No.

   No. of snubbers to be tested

8. What corrective action and recurrence controls are to be taken?

Evaluation performed by: ______________________________ ____________
Snubber Engineer/SE Designee Date

Attachment 4
(Page 1 of 1)

Supported System/Component Analysis for Inoperable Snubbers

WO No. ________________ Unit _______ Snubber UNID No. ______________

Subgroup No. _________ PER No. ______________ Mfg./Size ____________________

Serial No. ____________ Rated Load ___________ Exam No. ________

1. Describe the condition(s) (e.g., snubber would **NOT** activate, was locked up, damaged hardware etc.)

2. Attach the SE Evaluation of the attached component:

3. Based on the results of the Engineering Evaluation, has the snubber failure mode adversely affected the supported system or component?

   ☐ Yes ☐ No

_________________________________ ____________
Snubber Engineer/SE Designee Date

Attachment 5
(Page 1 of 2)

Evaluation of Loose or Missing Attachment Fasteners or of "As-Found" Stroke Setting Outside of Acceptable Range

This evaluation shall be performed when fasteners, used for attachment of snubber to component, and to snubber anchorage, are discovered loose or missing prior to the As-Found functional testing.This evaluation also shall be performed if the snubber "As-Found" setting is outside of the acceptance range specified on the design drawing.

WO No. ________________ Unit _____ Date Discovered _____________

Snubber UNID No. ___________ Serial No. ____________ Subgroup __________

Exam No. _________ Size ________ Rated Load _______ Lbs.

1. Describe the discovered condition and, if possible, determine cause:

________________________________ ______________

Performer Initials Date

Attachment 5
(Page 2 of 2)

Evaluation of Loose or Missing Attachment Fasteners or of "As-Found" Stroke Setting Outside of Acceptable Range

Items 2, 3, and 4 are to be completed by Site Engineering Civil.

2. Evaluate to determine whether the cause may be localized or generic. Use this evaluation to select and list other suspect snubbers for verification, as applicable.:

3. Describe the corrective action(s) and provide the As-Found test result.

4. Conclusion: Is the snubber operable? ______ YES ______ NO

   Justification:

   If "No", notify the Shift Manager or Unit Supervisor immediately. Then complete or request a failure analysis using Attachment 3, and a supported component or system analysis on Attachment 4, as necessary.

   Evaluated by: ______________________________ ____________
   Date

Tennessee Valley Authority
Browns Ferry Nuclear Plant, Unit 2

Relief Request No. 2-ISI-40, Snubbers Inspection and Testing

Relief Request No. 2-ISI-40, Reference J

Browns Ferry Nuclear Plant, Modification And Additions Instruction, MAI-4.10, "Piping Clearance Instruction"

TVA

Browns Ferry Nuclear Plant

Unit 0

Modification And Additions Instruction

MAI-4.10

Piping Clearance Instruction

Revision 0011

Quality Related

Level of Use: Information Use

Effective Date: 04-14-2010

Responsible Organization: MMG, Mechanical Maintenance

Prepared By: Annie M. Hackett

Approved By: Joseph R. Webb

Current Revision Description

Pages Affected: All

Type of Change: Intent Tracking Number: 013

This procedure has been converted from Word 95 to Word 2007 (XP) using Rev 10.

Table of Contents

1.0 PURPOSE

This procedure provides the requirements for new modification and maintenance work to ensure that sufficient space is available for thermal and seismic deflection of piping, components, and supports. Compliance with these requirements will ensure that piping is free to function with the as analyzed conditions without detrimental contact with other components/features and that all future work performed by plant personnel will not invalidate the analysis of Seismic Class I piping systems or Seismic Class II piping within the water spray program as evaluated by EQE Report 51001.02-R001. [See CAQR BFP870631 (R76 870831 894)]

2.0 SCOPE

Seismic Class I piping has been analyzed based on as built data obtained from piping system walkdowns. During the walkdowns, all objects within a 2" envelope of the piping were identified. Using the pipe movement data from the piping analyses, clearances were evaluated and modifications were performed as necessary. Where the piping analyses indicated movement greater than 2", additional walkdowns were performed to identify any potential interferences. In addition to the Seismic Class I piping, Seismic Class II water filled piping was walked down to evaluate water spray hazards for Unit 2 operation.

This MAI ensures that future modification and maintenance work does not invalidate these existing clearance evaluations.

This procedure applies to the following activities:

All new modification and maintenance activities (except for cases where identical replacement components are used) which could compromise the clearance envelope required for piping, components and supports for all units.

This is not to be construed to mean that existing objects (previously installed) less than 3" from the pipe need to be reported per this procedure. This only applies when a new item is added or an existing item is moved closer to the pipe than its original position.

3.0 REFERENCES

CAQR BFP 870631 (R76 870831 894)

DCN Q 26202A

EQE Report 51001.02 R001 Evaluation of Seismic Induced Spray Hazards at BFNP (B22 91 0215 101).

G-28 Construction of Piping Systems for Boiling Water Reactor Nuclear Power Plants.

3.0 REFERENCES (continued)

G-40 Installation, Modification, and Maintenance of Electrical Conduit, Cable Trays, Boxes, Containment Electrical Penetrations, Electrical Conductor Seal Assemblies, Lighting and Miscellaneous Systems.

G-43 Installation, Modification, and Maintenance of Pipe Supports and Pipe Rupture Mitigative Devices.

G-82 Installation, Modification, and Maintenance of Insulation.

G-94 Piping Installation, Modification, and Maintenance.

REG GUIDE 1.29

MMDP-1 Maintenance Management System.

NADP-1 Conduct of Quality Assessment and Inspection.

NEDP-11 Design Input Walkdown Controls

NUREG CR 4306

N1E-003 Instrument and Instrument Line Installation and Inspection.

N1M-001 Installation, Modification, and Maintenance of Thermal Anti Sweat Insulation.

SPP-3.1 Corrective Action.

SPP-8.3 Modification Test Program.

SPP-9.3 Plant Modification and Design Change Control.

3-47E491-837 - Mechanical Fire Protection System Plan EL 565.0.

4.0 DEFINITIONS

Piping For the purpose of this MAI, the term "piping" includes not only the pipe itself, but also pipe mounted components (e.g., valves, flanges, etc.) and pipe supports that may move with the pipe (e.g., rods, snubbers, stuts, etc.). "Piping" as used in this document, also encompasses tubing.

Clearance Envelope The space around the piping system/component being evaluated for potential interferences.

Responsible Engineer The engineer responsible for the activity being performed.

Interference An unintended restriction of the thermal or seismic displacement of piping.

Potential Clearance Discrepancy (PCD) Any item found infringing upon the clearance envelope as defined in this procedure.

Surface The outermost surface of the adjacent piping or component. Where insulation is required but not yet installed, the "surface" shall be that of the insulation when installed.

5.0 RESPONSIBILITIES

5.1 Site Modifications and Maintenance

Assure Maintenance and Modification work is performed without violation of the clearance envelope as defined in Section 6.1 and document on the applicable MAI Data Sheet.

If proposed installation creates violation of clearances, a PCD shall be initiated/checked by Field Engineering (FE) and forwarded to Site Engineering (SE) for approval.

5.2 Site Engineering

- Evaluate PCD.
- If a modification is required to resolve PCD, initiate a PIC or WO, as applicable.
- Return dispositioned PCD to Modification/Maintenance.

NOTE
No QC Inspection is required for this Procedure.

Potential clearance discrepancies that are identified on existing piping listed in Section 6.1 shall be identified and documented on MAI-4.10 Data Sheet 1 (PCD) by FE and dispositioned by Site Engineering.

New or revised components (Piping, Pipe supports, etc.) are subject to applicable procedure clearance requirements.

6.0 PROCEDURE/ACCEPTANCE CRITERIA

6.1 Clearance Requirements

Seismic Class I piping and Seismic Class II water filled piping is considered as requiring a nominal clearance of 3" from the surface (see definitions) to permit thermal and seismic motions without detrimental contacts with any other elements of the plant. Nominal clearance less than 3" which are shown and dimensioned on the design drawings are not required to be identified as a discrepancy. All other clearance discrepancies shall be documented on the Potential Clearance Discrepancy (PCD) and submitted to Site Engineering for evaluation. Consideration shall be given to the following drawings which show Unit 1, Unit 2 and Unit 3 and common piping with thermal movements greater than 3".

1-47B400-2001, Main Steam piping inside Unit 1 drywell (A Main Steam Line)

1-47B400-2002, Main Steam piping inside Unit 1 drywell (B Main Steam Line)

1-47B400-2003, Main Steam piping inside Unit 1 drywell (1" Drain off 10" Supply to HPCI)

1-47B400-2004, Main Steam piping inside Unit 1 drywell (C Main Steam Line)

1-47B400-2005, Main Steam piping inside Unit 1 drywell (C Main Steam Line)

1-47B400-2006, Main Steam piping inside Unit 1 drywell (D Main Steam Line)

1-47B400-2007, Main Steam piping inside Unit 1 drywell (3" Steam Line Drain)

1-47B400-2008, Main Steam piping inside Unit 1 drywell (3" Steam Line Drain)

1-47B401-2001, Main Steam SRV piping inside Unit 1 drywell (1-PCV-1-18)

1-47B401-2002, Main Steam SRV piping inside Unit 1 drywell (1-PCV-1-19)

1-47B401-2003, Main Steam SRV piping inside Unit 1 drywell (1-PCV-1-22)

1-47B401-2004, Main Steam SRV piping inside Unit 1 drywell (1-PCV-1-31)

1-47B401-2005, Main Steam SRV piping inside Unit 1 drywell (1-PCV-1-30)

1-47B401-2006, Main Steam SRV piping inside Unit 1 drywell (1-PCV-1-41)

1-47B401-2007, Main Steam SRV piping inside Unit 1 drywell (1-PCV-1-4)

1-47B415-2001, Reactor Water Level Ref. Leg piping inside Unit 1 drywell (Nozzle N12B)

1-47B415-2002, Reactor Head LP Seal Leakoff piping inside Unit 1 drywell

6.1 Clearance Requirements (continued)

1-47B415-2003, Reactor Head HP Seal Leakoff piping inside Unit 1 drywell

1-47B455-2001, HPCI piping in Unit 1 reactor building (14" pipe)

1-47B455-2002, HPCI piping inside Unit 1 drywell (10" supply off of Main Steam Line)

1-47B465-2001, RPV Head Vent piping inside Unit 1 drywell

1-47B465-2002, RPV Head Vent piping inside Unit 1 drywell

1-47B465-2003, RPV Head Vent piping inside Unit 1 drywell

1-47B468-2001, CRDH piping in Unit 1 reactor bldg (vicinity of support 1-47E468-131)

1-47B468-2002, CRDH piping in Unit 1 reactor bldg (vicinity of support 1-47E468-115)

1-47B468-2003, CRDH piping in Unit 1 reactor bldg (vicinity of support 1-47E468-123)

1-47B468-2004, CRDH piping in Unit 1 reactor bldg (vicinity of support 1-47E468-131)

1-47B468-2005, CRDH piping in Unit 1 reactor bldg (vicinity of support 1-47E468-120)

1-47B468-2006, CRDH piping in Unit 1 reactor bldg (vicinity of support 1-47E468-122)

1-47B468-2007, CRDH piping in Unit 1 reactor bldg (vicinity of support 1-47E468-125)

1-47B468-2008, CRDH piping in Unit 1 reactor bldg (vicinity of support 1-47E468-125)

2-47B400-2001, Main Steam SRV piping inside Unit 2 drywell

2-47B400-2002, Main Steam SRV piping inside Unit 2 drywell

2-47B400-2003, Main Steam SRV piping inside Unit 2 drywell

2-47B400-2004, Main Steam SRV piping inside Unit 2 drywell

2-47B400-2005, Main Steam SRV piping inside Unit 2 drywell

2-47B400-2006, Main Steam SRV piping inside Unit 2 drywell

6.1 Clearance Requirements (continued)

2-47B400-2007, Main Steam SRV piping inside Unit 2 drywell

2-47B400-2008, Main Steam SRV piping inside Unit 2 drywell

2-47B400-2009, Main Steam SRV piping inside Unit 2 drywell

1-47B451-2001, EECW piping in Unit 1 reactor building

1-47B451-2002, EECW piping in Unit 1 reactor building

1-47B451-2003, EECW piping in Unit 1 reactor building

2-47B451-2004, EECW piping in Unit 2 reactor building

2-47B451-2005, EECW piping in Unit 2 reactor building

2-47B451-2006, EECW piping in Unit 2 reactor building

2-47B452-2001, RHR piping in Unit 2 reactor building

2-47B455-2001, HPCI piping in Unit 2 reactor building

2-47B456-2001, RCIC piping in Unit 2 reactor building

2-47B465-2001, RPV vent piping, inside Unit 2 drywell

0-47B590-2001, CO_2 piping, in Unit 1 reactor building

2-47B600-2001, Sample and Water Quality piping, inside Unit 2 drywell

2-47B600-2002, Control Air piping in Unit 2 reactor building

2-47B600-2003, Containment Inerting piping in Unit 2 reactor building

2-47B600-2004, Containment Inerting piping in Unit 2 reactor building

2-47B600-2005, Containment Inerting piping in Unit 2 reactor building

2-47B600-2006, Containment Inerting piping in Unit 2 reactor building

2-47B650-2001, Feedwater instrument piping in Unit 2 drywell

3-47B400-2001, Main Steam SRV piping inside Unit 3 drywell

3-47B400-2002, Main Steam SRV piping inside Unit 3 drywell

3-47B400-2003, Main Steam SRV piping inside Unit 3 drywell

3-47B400-2004, Main Steam SRV piping inside Unit 3 drywell

6.1 Clearance Requirements (continued)

3-47B400-2005, Main Steam SRV piping inside Unit 3 drywell

3-47B400-2006, Main Steam SRV piping inside Unit 3 drywell

3-47B400-2007, Main Steam SRV piping inside Unit 3 drywell

3-47B400-2008, Main Steam SRV piping inside Unit 3 drywell

3-47B400-2009, Main Steam SRV piping inside Unit 3 drywell

3-47B400-2010, Main Steam Drain Piping inside Unit 3 drywell

3-47B465-2001-1, RPV Head Vent piping inside Unit 3 drywell

3-47B465-2001-2, RPV Head Vent piping inside Unit 3 drywell

3-47B462-2001, Standby Liquid Control piping in Unit 3 reactor building

3-47B451-2001, EECW piping in Unit 3 reactor building

3-47B406-2001, RWCU piping in Unit 3 reactor building

3-47B456-2001, RCIC piping in Unit 3 reactor building

3-47B456-2005, RCIC piping in Unit 3 reactor building

3-47B455-2113, HPCI piping in Unit 3 reactor building

3-47B455-2114-1, HPCI piping in Unit 3 reactor building

3-47B455-2114-2, HPCI piping in Unit 3 reactor building

3-47B468-2001, CRD Scram Discharge piping in Unit 3 reactor building

3-47B468-2002, CRDH piping in Unit 3 reactor building

3-47B468-2003, CRDH piping in Unit 3 reactor building

3-47B468-2004, CRDH piping in Unit 3 reactor building

3-47B468-2005, CRDH piping in Unit 3 reactor building

3-47B468-2006, CRDH piping in Unit 3 reactor building

3-47B415-2001, Reactor Head Low Pressure Seal Leakoff piping inside Unit 3 drywell

6.1 Clearance Requirements (continued)

3-47B415-2002, Reactor Head High Pressure Seal Leakoff piping inside Unit 3 drywell

3-47B600-2001, Reactor Vessel Level Instrumentation piping inside Unit 3 drywell

The clearance requirements apply to piping and all components associated with the piping including valves and their operators, in-line tanks and filters, pumps, equipment, or supports which are not fixed to a foundation and moves with the piping system. If the other component is a pipe, the pipe clearance envelope is doubled. Field activities that infringe upon this 3" envelope shall be documented as defined in this procedure.

Clearances from Unit 3 Fire Protection (FP) piping, down stream of the FP Flow Control Valves 3-FCV-26-77 and 3-FCV-26-37 shall be in accordance with Drawing 3-47E491-837.

Piping within an instrument panel is excluded from the requirements of this procedure when the piping, and the components within the clearance envelope of the piping, are all attached to the panel.

Tubing within tube track is also excluded from the requirements of this procedure, except when the tube track is within 3" of a pipe.

Special attention should be paid to equipment with moving parts such as rising stems on valves. Sufficient clearance must be maintained for moving parts to cycle to their limits and still provide minimum required clearance (3") to other components or features.

When checking clearance envelope of uninsulated piping, verify that this piping will remain uninsulated, and is not required to be insulated by design output documents. (Refer to 0-47E235 series drawings - System Insulation Boundaries.)

6.1 Clearance Requirements (continued)

All modification or maintenance work in the areas listed below shall meet the clearance requirements of this procedure: minimum of 3" between the surface of the pipe and the modified component or feature.

- Reactor Building (including the Control Bay)
- Reinforced Concrete Chimney
- Pumping Station Structure, including the Residual Heat Removal
- Service Water Intake Structure
- Diesel Generator Buildings
- Equipment Access Lock
- Standby Gas Treatment Building
- Off Gas Treatment Building
- Vacuum Pump Building
- Radwaste Building: exterior wall adjacent to Diesel Generator Building (Waste Surge and Waste Collection Tank Room)

Any infringement of the clearance envelope should be evaluated prior to or at the time of installation to limit the impact should rework be required.

NOTE
If the PCD can be eliminated by notching insulation in accordance with Specification G-82, the Responsible Engineer shall submit a Work Order (WO) to have the insulation notched. If insulation notching will not resolve the PCD, the PCD will be transmitted to Site Engineering.

7.0 RECORDS

Data Sheet 1 - Potential Clearance Discrepancy Form

The completed PCD is a QA record and will be retained as a lifetime record by Records Management (RM). Working files are classified as nonpermanent QA records. Appropriate requirements are addressed in SPP-2.4.

A copy of the completed PCD will be kept with the work document and the original Data Sheet 1 will be transmitted to SE Lead Civil Engineer prior to/or upon closure of the work document.

Tennessee Valley Authority
Browns Ferry Nuclear Plant, Unit 2

Relief Request No. 2-ISI-40, Snubbers Inspection and Testing

Relief Request No. 2-ISI-40, Reference K

Comparison of TRM Program to ASME OM, Part 4

Reference K: Comparison of TRM Program to ASME OM, Part 4

OM Part 4, Section 1.5.6, Snubber Maintenance or Repair - Maintenance or repair activities which can alter the snubber's intended function shall be evaluated by considering the effects of maintenance or repair on the snubber's ability to meet the snubber examination criteria. Maintenance or repair activities that affect the ability of the snubber to satisfy its intended function shall be completed in accordance with written procedures. Snubbers which undergo maintenance or repair activities which could alter the snubber's ability to perform its intended function shall be examined and tested in accordance with the applicable requirements of paragraphs 2.3.1.2 and 3.2.1.1. The requirements selected shall ensure that the function(s) which may be affected are verified by the examination and tests to be acceptable.

For BFN, Unit 2, the alternative requirements for Snubber Maintenance or repair is provided as follows.

TSR 3.7.4.6 requires verification that replacement snubbers and snubbers having repairs, which might affect the functional test results, meet the test criteria of TSR 3.7.4.2.

a. These snubbers shall have met the acceptance criteria subsequent to their most recent service; and

b. The functional test must have been performed within the 12 months prior to being installed in the unit.

The frequency of TSR 3.7.4.6 is once prior to installation in the unit for each replacement snubber and each snubber which has repairs which might affect functional test results.

0-TI-398, Revision 9, Section 7.18, Rebuilding of Hydraulic Snubbers states: Rebuilding of hydraulic snubbers shall be performed by task qualified and trained persons. Hydraulic snubbers shall be rebuilt in accordance with the following procedures, and MPI-0-000-SNB002, Hydraulic Shock and Sway Arrestor Bergen-Paterson, Anchor/Darling, Fronek Unit Disassembly and Reassembly, as appropriate. MPI-0-000-SNB002, Revision 19, Section 6.0 states: Rebuilt snubber shall pass functional test criteria in 0-SI-4.6.H-2B.

OM Part 4 Section 2.1.1a) There are no visible signs of damage or impaired operability as a result of storage, handling or installation.

TSR 3.7.4.1 requires performance of a visual inspection of required snubber(s) based on the criteria of Table 3.7.4-1 for each population or category to verify:

a. No visible indications of damage or impaired OPERABILITY;

b. Attachments to the foundation or supporting structure are functional; and

c. Fasteners for the attachment of the snubber to the component or system and to the snubber anchorage are functional. The discovery of loose or missing attachment fasteners will be evaluated to determine whether the cause may be localized or generic.

The proposed alternative does not differentiate between damage or impaired operability storage, handling, of installation only that there is no visible indications of damage or impaired operability.

The alternate requirements in the BFN Surveillance Instruction (SI) 2-SI-4.6.H-1, Revision 33, Attachment 2, "Visual Examination Checklist for All Snubbers" checklist Item A reads: "The snubber has no visible indications of damage or impaired operability" and specifically includes observing the exposed parts of the snubber for broken parts, deformation, or other damage that could result in unacceptable performance.

OM Part 4 Section 2.1.1b) the snubber load rating, location, orientation, position setting, and configuration (attachments, extensions, etc.) are in accordance with design drawings and specifications. Installation records (based on physical inspections) verifying the snubbers were installed according to design drawings and specifications shall be acceptable in meeting this requirement.

TR 3.7.4 does not specifically address verification of the snubber load rating, location, orientation, position setting, and configuration (attachments, extensions, etc.) are in accordance with design drawings and specifications. However, these requirements are fulfilled by TR 3.7.4 program procedures.

The BFN alternate requirements in SI 2-SI-4.6.H-1 are as follows:

Section 7.2 G states "The snubbers are assigned a UNID number in an appropriate tracking program, which provides current and historical information for a specific snubber or support location." Section 7.2 H states "The snubbers are listed in Appendix A by exam number." Appendix A provides additional information such as snubber drawing no., type/size, support number, and location. Snubber drawing number may be used to access the design drawing of a snubber, showing the location plan, material description, orientation, configuration (to include attachments, extensions and others), design requirements such as design travel/thermal movements and position settings. Section 7.2 I of the SI states that "A unique snubber/support number is given to each snubber location on a system."

MPI-0-000-SNB004, Revision 37, Attachment 1, Note 2 states: "Document removal and reinstallation data for the snubber on Attachment 4." Snubber data listed in Attachment 4 relevant to these requirements includes: As-Found Position Indication Reading (for mechanical type), As-Found Index (Plunger) Reading, As-Found Piston Reading, and others (for hydraulic type). Collection and recording data in Attachment 4 is done prior to removal of the snubber for functional testing and after reinstallation.

OM Part 4 Section 2.1.1c) adequate swing clearance is provided to allow snubber movement.

TSR 3.7.4.1 requires a visual inspection of required snubber(s) based on the criteria of Table 3.7.4-1 for each population or category to verify: a. No visible indications of damage or impaired OPERABILITY; b. Attachments to the foundation or supporting structure are functional; and c. Fasteners for the attachment of the snubber to the component or system and to the snubber anchorage are functional. The discovery of loose or missing attachment fasteners will be evaluated to determine whether the cause may be localized or generic. This inspection is conducted in accordance with 2-SI-4.6.H-1.

The BFN alternative states that the item is to be observed in performance of visual SI 2-SI-4.6.H-1. Attachment 2 of the SI contains the following verifications: Centerline of the clamp assembly and structural attachment offset (i.e., a misalignment with the snubber axis exists) by no greater than plus or minus 6 degrees based on the clearances between the rod eyes, paddles, and the attachment clevis. Contact of these parts, which produces a side load on the snubber is unacceptable. Observe spacers are installed on each side of the snubber eye to reduce the misalignment and or binding. Space shall not exceed 1/16 inch on either side or 1/8 inch total. Observe for evidence of torsional binding (i.e. mechanical snubber twisted along its axis by the pipe clamp and structural attachments).

OM Part 4 Section 2.1.1d) if applicable, fluid is at the recommended level and fluid is not leaking from the snubber system.

TSR 3.7.4.1 requires a visual inspection of required snubber(s) based on the criteria of Table 3.7.4-1 for each population or category to verify: a. No visible indications of damage or impaired OPERABILITY; b. Attachments to the foundation or supporting structure are functional; and c. Fasteners for the attachment of the snubber to the component or system and to the snubber anchorage are functional. The discovery of loose or missing attachment fasteners will be evaluated to determine whether the cause may be localized or generic. This inspection is conducted in accordance with 2-SI-4.6.H-1.

The BFN Alternate fluid level acceptability check for hydraulic snubbers is included in the visual SI 2-SI-4.6.H-1 data sheets or Attachments 3, 4, 5, and 9. Immediate notification of the Snubber Engineer (SE)/SE Designee is required. A Work Order to remove the snubber and take to the snubber test facility to have functional test performed is directed by the applicable Attachment. Bergen-Paterson Torus Dynamic Restraints found with unacceptable fluid levels are considered inoperable and the Shift Manager/Unit Supervisor is notified. Examination of the snubber for location and cause of leaks is performed. Leakage locations are recorded in Remarks section of the attachment. The Snubber Engineer/SE Designee performs an evaluation and documents the unacceptable condition on Attachment 8, as applicable, and initiates appropriate corrective action.

MPI-0-000-SNB004, Attachment 1, Section 1.0[1] states: "perform visual inspection of the snubber for any visible damage or fluid leakage." Further, Section 1.0[8.2] states: "if the fluid level is unacceptable, but not empty, add GE SF 1154 silicon fluid using a hydraulic fluid gun until the fluid level reading is at or approximately the same as the piston rod extension given above. Notify the Snubber Engineer/Designee to take appropriate action."

OM Part 4 Section 2.1.1e) structural connections such as pins, bearings, studs, fasteners, and other connecting hardware such as locknuts, tabs, wire and cotter pins are installed correctly.

TSR 3.7.4.1 requires a visual inspection of required snubber(s) based on the criteria of Table 3.7.4-1 for each population or category to verify: a. No visible indications of damage or impaired OPERABILITY; b. Attachments to the foundation or supporting structure are functional; and c. Fasteners for the attachment of the snubber to the component or system and to the snubber anchorage are functional. The discovery of loose or missing attachment fasteners will be evaluated to determine whether the cause may be localized or generic. This inspection is conducted in accordance with 2-SI-4.6.H-1.

The BFN Unit 2 alternate checklist items in SI 2-SI-4.6.H-1, Attachment 2, Item B states: "Attachments to the foundation or supporting structure are functional" and verifies the following attributes: "Observe the exposed hanger structural steel, pipe clamps, base plates, lugs and other such plates of attachment for broken parts, deformation or other damage" and "Observe welds for visible damage at base plates, lugs, and other such points of attachment."

Attachment 2, Item C states: "Fasteners for the attachment of snubber to the component and to the snubber anchorage are functional" and verifies the following attributes:

- Observe to ensure the security of essential threaded fasteners such as anchorage bolts and pipe clamp bolts that are exposed.
- Observe to ensure clevis bolts or pins are properly installed.
- Observe for the following attributes which may cause future problems but do not affect snubber operability or any acceptance criteria: pits, scratches, or rough places observed on the piston rod that would not contact the piston seal, cotter pins properly installed with legs bent sufficiently, but not completely, to prevent cotter pin from backing out, pivot pin retaining ring is properly installed, if required, and security locking devices (i.e., locking tabs or wire) on snubber attachment bolts properly installed, if required.

OM Part 4 Section 2.2, Pre-service Thermal Movement Examination

2.2.1 Pre-service Thermal Movement Examination Requirements. During initial system heat up and cool down, snubber thermal movement for systems whose design operating temperature exceeds 250 degrees F (121degrees C) shall be verified as follows.

(a) During initial system heat up and cool down at temperature plateaus specified by the Owner, record the thermal movement. Verify that the snubber movement during the thermal movement examination is within the design specified range. Any discrepancies or inconsistencies shall be evaluated to determine the movement acceptability prior to proceeding to the next specified plateau. The total thermal movement from cold to hot at full operating temperature shall be recorded. This value may be measured directly if maximum operating temperature was attained, or extrapolated from lower temperature readings. The cold or hot position setting shall be evaluated and adjusted if necessary to ensure adequate snubber clearance from fully extended or retracted positions.

(b) Verify that there is swing clearance at specified heat up and cool down plateaus.

Pre-service thermal movement examinations during initial system heat up and cool down were conducted in accordance with BFN plant procedures during initial plant startup. Pre-service thermal movement examinations, in accordance with this section, are not required.

OM Part 4 Section 2.3.1, Inservice Examination Requirements; Visual Examination for impaired functional ability; Visual Examination Requirements to verify snubbers can carry load, snubbers do not restrict movement, and verification of special features required for actuation.

See discussion for OM Part 4 sections 2.1.1a through 2.1.1e.

OM Part 4, Section 2.3.1.2, Visual Examination Requirements states:

The snubber installation must meet the following requirements:

a. **Snubbers shall be installed in such condition that they do not restrict the thermal movement to the extent that unacceptable overstressing could develop in the pipe or other equipment that the installation is designed to protect or restrain. If no indication of binding, misalignment, or deformation is observed, the provisions of this requirement are considered to be satisfied.**

TSR 3.7.4.1 requires a visual inspection of required snubber(s) based on the criteria of Table 3.7.4-1 for each population or category to verify: a. No visible indications of damage or impaired OPERABILITY; b. Attachments to the foundation or supporting structure are functional; and c. Fasteners for the attachment of the snubber to the component or system and to the snubber anchorage are functional. The discovery of loose or missing attachment fasteners will be evaluated to determine whether the cause may be localized or generic. This inspection is conducted in accordance with 2-SI-4.6.H-1.

The BFN alternative states that the item is to be observed in performance of visual SI 2-SI-4.6.H-1. Attachment 2 of the SI contains the following verifications: Centerline of the clamp assembly and structural attachment offset (i.e., a based on the clearances between the rod eyes, paddles, and the attachment clevis. Contact of these parts, which produces a side load on the snubber, is unacceptable. Observe spacers are installed on each side of the snubber eye to reduce the misalignment and or binding. Space shall not exceed 1/16 inch on either side or 1/8 inch total. Observe for evidence of torsional binding (i.e. mechanical snubber twisted along its axis by the pipe clamp and structural attachments).

b. Special features required for the actuation of the snubber shall be verified. For example, fluid supply or content for hydraulic snubbers shall be observed. Observation that the fluid level is equal to or greater than the minimum amount which is sufficient for actuation at its operating extension is considered to satisfy the provisions of this requirement for hydraulic snubbers. If the fluid is less than the minimum amount, the installation is to be identified as unacceptable unless a test is performed establishing that the performance of the snubber is within specified limits. Tests shall be performed in accordance with paragraphs 3.2.1.1(b) and 3.2.1.1(c) and the initial test shall start with the piston at the as-found setting and be performed in the extension (tension) direction.

0-TI-398, Appendix A, under Alternate Examinations states: The BFN Unit 2 TRM, TR 3.7.4, "Snubbers," requirements will be utilized for the examination and testing of snubbers for Pre-service, inservice, and repair/replacement activities. The procedures utilized for these examinations are 2-SI-4.6.H-1, "Visual Examination of Hydraulic and Mechanical Snubbers;" 0-SI-4.6.H-2A, "Functional Testing of Mechanical Snubbers;" 0-SI-4.6.H-2B, "Functional Testing of Bergen-Paterson, Anchor/Darling or Fronek Hydraulic Snubbers," 0-SI-4.6.H-2C, "Functional Testing of Bergen-Paterson Torus Dynamic Restraints," 0-SI-4.6.H-2E, "Functional Testing of Lisega Large Bore Torus Dynamic Restraints," 0-SI-4.6.H-2F, "Functional Testing of Lisega Type 30 Hydraulic Snubbers," and MPI-0-000-SNB004, "Instructions for Removing and Reinstalling Pacific Scientific Mechanical, Bergen-Paterson Hydraulic, Grinnell Hydraulic, and Bergen-Paterson or Lisega Torus Dynamic Restraints Snubbers." These examinations will include the pin-to-pin area inclusive of applicable snubbers.

When testing is performed by the manufacturer or a qualified vendor, the acceptance criteria contained in BFN surveillance procedures 0-SI-4.6.H-2A, 0-SI-4.6.H-2B, 0-SI-4.6.H-2C, 0-SI-4.6.H-2E, and 0-SI-4.6.H-2F are used to ensure testing performed meets program requirements.

Testing of repaired and replaced snubbers will also be performed in accordance with TR 3.7.4.

Visual examination of repaired and replaced snubbers will be performed in accordance with 2-SI-4.6.H-1, "Visual Examination of Hydraulic and Mechanical Snubbers."

Snubber examination and testing data will be maintained in accordance with the requirements of TR 3.7.4, the BFN corrective action program, NPG-SPP-03.1, and the implementing procedures (2-SI-4.6.H-1, 0-SI-4.6.H-2A, 0-SI-4.6.H-2B, 0-SI-4.6.H-2C, 0-SI-4.6.H 2E, 0-SI-4.6.H 2F, 0-TI-398, MPI-0-000-SNB002, and MPI-0-000-SNB004).

The areas inclusive of the pins back to building structure and to the component/piping being supported (integral and non-integral attachments for snubbers, including lugs, bolting, pins, and clamps) will remain in the ASME Section XI examination boundary in accordance with Subsection IWF and examined using the VT-3 visual examination method described in IWA-2213.

OM Part 4 Section 2.3.2, Inservice Examination Frequency

TSR 3.7.4.1 requires performance of a visual inspection of snubbers with the frequency based on TRM Table 3.7.4-1, "Snubber Visual Inspection Interval." Also, see discussion for OM Part 4 section 3.2.2.

OM Part 4 Section 2.3.3, Inservice Examination Sample Size

The following criteria shall be utilized to establish inservice examination sample size.

(a) The initial inservice examination of snubbers required by para. 2.3.2.1 shall include all (100%) of the snubbers of all groups as may have been established under the provisions of para. 1.6.

(b) Subsequent inservice examinations shall include all (100%) of the snubbers of all groups.

After two successive examination intervals, at the maximum time interval allowed in para. 2.3.2.2, the sample size for the next required examination of the group may be reduced if justified by the Owner and accepted by the regulatory authority having jurisdiction over the facility.

The inservice examination sample size for BFN Unit 2 is established in accordance with TRM Table 3.7.4 1. TSR 3.7.4.1 requires performance of a visual inspection of snubbers with the frequency based on TRM Table 3.7.4 1. Also, see discussion for OM Part 4 section 3.2.2.

OM Part 4, Section 2.3.4.1, Failure Evaluation. Snubbers which fail to meet the examination acceptance criteria shall be evaluated to determine the cause of the unacceptability.

TRM section TSR 3.7.4.1 states: Snubbers which appear inoperable as a result of visual inspection shall be classified unacceptable and may be reclassified acceptable for the purpose of establishing the next visual inspection interval, provided that (1) the cause of the rejection is clearly established and remedied for that particular snubber and for other snubbers irrespective of type that may be generically susceptible; and (2) the affected snubber is functionally tested in the as found condition and determined OPERABLE per the criteria of TSR 3.7.4.2. A review and evaluation shall be performed and documented to justify continued operation with an unacceptable snubber. If continued operation cannot be justified, the system or train shall be declared inoperable.

Additionally, TRM section TSR 3.7.4.3 states: A failure analysis shall be made of each failure to meet the functional test acceptance criteria of TSR 3.7.4.2 to determine the cause of the failure.

OM Part 4, Section 2.3.4.2, Functional Test Evaluation, The snubber(s) that is found to be unacceptable as a result of inservice examination may be tested in accordance with requirements of paragraph 3.2, provided the testing can resolve the unacceptable condition. Results which satisfy the operability test criteria may be used to re-categorize the snubber(s) as acceptable.

See discussion for OM Part 4, Section 2.3.4.1 above.

OM Part 4, Section 2.3.4.3, Examination Failure Mode Groups - Unacceptable snubbers shall be categorized into examination failure mode groups. An examination failure mode group shall include all unacceptable snubbers which have a given failure and all other snubbers subject to the same failure, except as permitted to be considered separately under paragraph 1.6. The examination failure mode groups shall be distinct for examination purposes from any testing failure mode groups. The following examination failure mode groups shall be used:

(a) Design/manufacturing

(b) Application induced

(c) Maintenance/repair/installation

(d) Isolated

(e) Unexplained

The BFN Snubber Program does not categorize examination failures into failure mode groups, although, as reported in the above response to OM Part 4, Section 2.3.4.1, the cause of all examination failures is established and remedied for that particular snubber and for other snubbers that may be generically susceptible.

In accordance with 0-TI-398, Snubber Program Procedure, snubber failures are classified as follows:

Location - A failure of a snubber(s) resulting from environmental conditions. Examples include failure of a snubber due to excessive heat, failure due to excessive local system vibration or failure due to other localized anomalies.

Manufacturing - A failure resulting from a potential defect in manufacturing. Examples include incorrectly assembled snubbers, inclusion of incorrect piece parts and failure of a snubber(s) due to improper or incorrect maintenance or repair practices performed by the vendor.

Design - A failure resulting from an error in the design. This classification would include incorrectly sized snubbers, snubbers provided with insufficient travel, snubbers with insufficient swing margins and design misapplications or errors.

Unknown - A failure that cannot be categorized as location, manufacturing, design, or other. This includes all failures for which the cause of failure cannot be determined.

Other - When the unknown cause of the failure cannot be categorized as location, manufacturing or design. This classification would include snubbers that fail due to end of service life. Additional examples include failure of snubbers due to plant transients, misapplication of rigging loads to the snubber and incidental interaction of tools or equipment on the snubber.

0-TI-398 sections 7.19.2A.3 and 7.19.2A.4 provide the following scope expansion and additional testing requirements due to the failure mode:

If the failure was found as part of the Technical Requirements Manual initial or any subsequent samples the following is the minimum required testing expansion:

a. Expand the sample by 10% of the remaining snubbers in the subgroup, and

b. If the cause of the failure is determined to be a system transient, test all snubbers on that system, which could have been affected by the transient, and

c. If the cause is a generic manufacturing defect, test all snubbers of that same type, and

d. Identify and test all other snubbers suspected of the same failure mode.

If the failure was found outside of the TRM initial or any subsequent samples (i.e., other maintenance activity, testing directed/requested by the Snubber Engineer, Service Life Monitoring testing, testing of snubbers on non-Technical Specification or TRM systems, etc.) the following is the minimum required testing expansion:

a. If the cause of the failure is determined to be a system transient, test all snubbers on that system, which could have been affected by the transient, and

b. If the cause is a generic manufacturing defect, test all snubbers of that same type, and

c. Identify and test all other snubbers suspected of the same failure mode.

OM Part 4, Section 2.3.4.4, Examination Failure Mode Group Boundaries. Once an examination failure mode group has been established, any snubber(s) in that examination failure mode group(s) will not be part of the examination group(s) from which the snubber originated except as noted in paragraph 2.3.4.5 below. The new examination failure mode group will remain as defined until:

(a) The examination failure mode group has reached the maximum time interval allowed

(b) Replacement/modification action in accordance with paragraphs 2.3.5.1(a) or (c), or paragraph 2.3.5.2 provides an examination failure group with all acceptable snubbers.

See discussion for OM Part 4, Section 2.3.4.3 above.

OM Part 4, Section 2.3.4.5, Snubbers in More Than One Failure Group - Any snubber(s) which is in more than one examination failure mode group, the examination schedule for that snubber will be determined by the examination failure mode group with the shortest examination schedule.

See discussion for OM Part 4, Section 2.3.4.3 above.

OM Part 4 Sections 2.3.4.3 through 2.3.5.4, which address Failure Mode Groups and Corrective Actions

See discussion for OM Part 4 section 3.2.4.2.

OM Part 4 Sections 2.3.5.5, Supported Component(s)/System Evaluation.

See discussion for OM Part 4 section 3.2.4.1.

OM Part 4 Section 2.3.4.1, Failure Evaluation; Section 2.3.4.2, Functional Test Evaluation

See discussion for OM Part 4 section 2.4 d.

OM Part 4 Section 2.4 a) checklists verifying Pre-service and inservice examination, fluids levels, and as-found conditions. Appendix A of this Part represents items normally included in a checklist (as follows):

- **Rotated reservoirs (hydraulic fluid could not reach valve blocks)**

  BFN, Unit 2 does not have rotated reservoirs as a specific snubber checklist item. Reservoir inventory is verified in 2-SI-4.6.H-1 for the hydraulic snubber models installed on BFN, Unit 2. The models installed have pressurized hydraulic reservoirs that allows mounting in any spatial orientation.

- **Piston shaft painted, which could cause a frozen condition**

  The BFN, Unit 2 alternate requirements are provided in SI 2-SI-4.6.H-1, Attachment 2, Section A that contains the following checklist item: "The snubber has no visible indications of damage or impaired operability." This item includes the following verifications: "Observe for any signs of overstressing, Observe the exposed parts of the snubber for broken parts, deformation or other damage, such as weld arc strikes, paint, weld slag, adhesive, or other deposits on piston rod or support cylinder that could result in unacceptable snubber performance, Observe to see if there is any evidence that a snubber has experienced a potentially damaging transient since the last examination, and Observe the snubber and piston rod for excessive corrosion, solid deposits, which could impair operability of the snubber."

- **Units installed upside down**

  The BFN, Unit 2 alternate requirements are provided in SI 2-SI-4.6.H-1, Section 6.0 A. 4 which states: "The snubber has the proper orientation, and adequate fluid level, if applicable." MPI-0-000-SNB004, Attachment 3, Section 2.0[11] verifies for Lisega Torus Dynamic Restraints, that the 2-way ball valve positioner is in the vertical position.

- **Sight glass broken**

  The BFN, Unit 2 alternate requirements are provided in SI 2-SI-4.6.H-1, Attachment 2, Section A contains the following verification: "The snubber has no visible indications of damage or impaired operability. Observe the exposed parts of the snubber for broken parts, deformation or other damage, such as weld arc strikes, paint, weld slag, adhesive, or other deposits on piston rod or support cylinder that could result in unacceptable snubber performance."

- **Installed with preset shipment screws for shipping (screws must be removed before service)**

  The BFN, Unit 2 functional testing of snubbers demonstrates free/unrestricted snubber movement in tension and compression directions. For a snubber to move freely, the preset shipment screws for shipping must be removed before the test. There is no preset shipment screw for shipping to remove on a Lisega Torus Dynamic Restraints.

- **Hydraulic fluid lines for snubber remote reservoir placed too close to hot pipe causing the lines to burst**

  BFN currently has no snubbers with remote reservoirs. The BFN Unit 2 alternate requirements are provided in MAI-4.2A Piping/Tubing Support Installation Data Sheet which documents clearances per MAI-4.10 applicable to SR, QR, or NQR supports in Category 1 Structures. MPI-0-000-SNB004, Attachment 1, section 2.1, Note (2) states that: "Any required relocation of the strut attachment to clear an interference should be brought to the attention of Site Engineering (Civil)."

- **Snubber placed in wrong location**

  The BFN, Unit 2 alternate requirements are provided in SI 2-SI-4.6.H-1, Section 7.2.G, which states "The snubbers are assigned a UNID number in an appropriate tracking program, which provides current and historical information for a specific snubber or support location." Section 7.2.H states: "The snubbers are listed in Appendix A by exam number." Note: Appendix A also provides a specific location of a snubber with a unique identification number (UNID).

- **Clevis pins not attached to anchor**

  The BFN, Unit 2 alternate requirements are provided in SI 2-SI-4.6.H-1, Attachment 2, Section C, which states: "Fasteners for the attachment of the snubber to the component and to the snubber anchorage are functional. Observe to ensure the security of essential threaded fasteners such as anchorage bolts and pipe clamp bolts that are exposed. Observe to ensure clevis bolts or pins are properly installed."

- **Snubber not installed at correct location**

  The BFN, Unit 2 alternate requirements are provided in 2-SI-4.6.H-1, Section 7.2.G, which states: "The snubbers are assigned a UNID number in an appropriate tracking program, which provides current and historical information for a specific snubber or support location." Section 7.2.H states: "The snubbers are listed in Appendix A by exam number." Note: 2-SI-4.6.H-1, Appendix A also provides a specific location of a snubber with a unique identification number (UNID).

- **Bent or scored piston rod**

  The BFN, Unit 2 alternate requirements are provided in 2-SI-4.6.H-1, Attachment 2, Section A, which states: "The snubber has no visible indications of damage or impaired operability. Observe the exposed parts of the snubber for broken parts, deformation or other damage, such as weld arc strikes, paint, weld slag, adhesive, or other deposits on piston rod or support cylinder that could result in unacceptable snubber performance."

- **Welding arc strikes**

  The BFN, Unit 2 alternate requirements are provided in 2-SI-4.6.H-1, Attachment 2, Section A, which states: "The snubber has no visible indications of damage or impaired operability. Observe the exposed parts of the snubber for broken parts, deformation or other damage, such as weld arc strikes, paint, weld slag, adhesive, or other deposits on piston rod or support cylinder that could result in unacceptable snubber performance."

- **Lubrication of pivot points**

  The BFN, Unit 2 alternate requirements are provided in MPI-0-000-SNB004, Attachment 2, Section 2.0[4], which states: "Apply anti-seize thread lubricant to the surface of the pivot pins and to all threaded fasteners that are being installed."

- **Abnormal spherical bearing position**

  The BFN, Unit 2 alternate requirements are provided in MPI-0-000-SNB004 Section 7.2[3], which states: "If a spherical bearing is found to be dislodged from the paddle housing, REINSERT by carefully pressing or tapping on the outer race. Use a Bergen-Paterson bearing installation tool or an appropriate sized pipe to assure proper alignment." MPI-0-000-SNB004, Section 7.2[3.2] states: "After the spherical bearing has been reinserted into the paddle if required, USE a center punch and MOVE approximately 1/32 inch away from the exterior of the spherical bearing race and with as little force as possible MAKE four punch indentations equally spaced around the race at approximately 90 degrees, on both sides of the paddle."

- **Protective coverings or plugs removed (after shipping or maintenance)**

  Snubbers received from the warehouse are free of protective coverings or plugs removed and ready for examination and testing, as required.

- **Fluid level indicators and/or position indicators accessible for visual inspection**

  The BFN, Unit 2 alternate requirements are provided in MPI-0-000-SNB004, Attachment 1 Section 2.2[10], which states: "At the end of each installation, CHECK each unit as a precaution for the following information."

  - Snubber Serial Number.
  - Piston rod extension dimension.
  - Fluid level indicator reading.
  - Whether or not fluid was added to bring unit to proper level.
  - Visible condition of the unit.
  - Condition of the strut assembly with particular attention to the clamp and the bolting tightness.
  - Cotter pins installed in clevis pins.

- **No visible corrosion or mechanical defects of working parts or surfaces**

  The BFN, Unit 2 alternate requirements are provided in 2-SI-4.6.H-1, Attachment 2, Section A, which states: "The snubber has no visible indications of damage or impaired operability. Observe the exposed parts of the snubber for broken parts, deformation or other damage, such as weld arc strikes, paint, weld slag, adhesive, or other deposits on piston rod or support cylinder that could result in unacceptable snubber performance. Observe the snubber and piston rod for excessive corrosion, solid deposits, which could impair operability."

OM Part 4 Section 2.4 b) examination records

All examination records are documented in Attachments 2, 3, 4, 5, and 9 of the 2-SI-4.6.H-1 and in Attachment 4 of MPI-0-000-SNB004. Visual examination records performed to facilitate testing are also documented in the appropriate attachments of applicable SIs 0-SI-4.6.H-2A, 0-SI-4.6.H-2B, 0-SI-4.6.H-2C, 0-SI-4.6.H-2E, and 0-SI-4.6.H-2F.

OM Part 4 Section 2.4 c) thermal movement inspection records

The stroke setting (As Found/As Left), which relates to thermal movement (shown in design drawings) for a given snubber, are documented in Attachment 4 of MPI-0-000-SNB004, Attachments 2, 3, 4, and 5 of 2-SI-4.6.H-1, and in the appropriate attachments of the applicable SIs: 0-SI-4.6.H-2A, 0-SI-4.6.H-2B, 0-SI-4.6.H-2C, 0-SI-4.6.H 2E, and 0-SI-4.6.H 2F.

OM Part 4 Section 2.4 d) nonconformance and corrective action required to be completed during the Pre-service and inspection interval

The BFN Unit 2 alternate requirements are provided in 2-SI-4.6.H-1, Section 7.2[F], which states: Evaluation sheets (Attachments 5, 6, and 7) shall be prepared and submitted with the data package, as appropriate, by the Snubber Engineer/Designee for each degraded or inoperable snubber identified by the performance of this instruction.

Section 7.3.1[1] states: "If any snubber is determined to be inoperable, Site Engineering Civil should initiate a Problem Evaluation Report (PER). Mechanical Maintenance Group (MMG) Planning should write a minor maintenance Work Order (WO) to perform the necessary repairs required to return the inoperable snubber to operable status." The checklist in Attachment 2, Sections A, B, and C states: "Responses marked (UNAC) are unacceptable and require immediate notification of the Snubber Engineer/SE Designee at the time of discovery. Handling of deficiencies shall be completed in accordance with NPG-SPP-06.9.1 and NPG-SPP-03.1."

OM Part 4 Section 3.1 Pre-service Operability Testing

3.1.1 Pre-service Operability Testing Requirements.

Pre-service operability testing shall be performed on all snubbers. Testing may be at the manufacturer's facility. The testing shall verify that:

(a) The force that will initiate motion (breakaway force), the force that will maintain low velocity displacement (drag force), or both, as required by the documents of para. 1.5.2, are within specified limits, both in tension and compression;

(b) Activation is within the specified range of velocity or acceleration in both tension and compression; (c) release rate, where applicable, is within the specified range in tension and compression. For units specifically required not to displace under continuous load, the ability of the snubber to withstand load without displacement shall be demonstrated.

For BFN Unit 2, the alternative requirements for Snubber Maintenance or repair is provided as follows.

TSR 3.7.4.6 states verify replacement snubbers and snubbers having repairs which might affect the functional test results meet the test criteria of TSR 3.7.4.2.

a. These snubbers shall have met the acceptance criteria subsequent to their most recent service; and

b. The functional test must have been performed within the 12 months prior to being installed in the unit.

When testing is performed by the manufacturer or a qualified vendor, the acceptance criteria contained in BFN surveillance procedures 0-SI-4.6.H-2A, 0-SI-4.6.H-2B, 0-SI-4.6.H-2C, 0-SI-4.6.H-2E, and 0-SI-4.6.H-2F are used to ensure testing performed meets program requirements.

OM Part 4 Section 3.2.1.1 a) the force that will initiate motion (breakaway force), the force that will maintain low velocity displacement (drag force), or both, as required by the documents of Paragraph 1.5.2 (Procedures and Instructions), is within specified limits, both in tension and compression

Drag tests performed on snubbers are in accordance with 0-SI-4.6.H-2A, 0-SI-4.6.H-2B, 0-SI-4.6.H-2C, 0-SI-4.6.H 2E, and 0-SI-4.6.H 2F and generally use the STB 200 Test Bench. Drag test result/computer printout is a graph of Velocity (ipm), Position (inches) and Force (lbs).

0-SI-4.6.H-2A, Revision 11, Section 6.0B states: The snubber functional test shall verify that:

1. "As Found"

   a. Activation (restraining action) occurs, in both tension and compression. Snubbers with activation values less than or equal to 0.04 g's are acceptable. The measured value shall be rounded to the second decimal place. Activation values greater than 0.04 g's shall be considered as a failure (inoperable snubber), require a failure analysis, and be evaluated for additional scope or expansion testing.

   b. The drag force shall not exceed the maximum acceptable drag force from Table 6.2-1 of the procedure.

2. "As Left"

   a. Activation (restraining action) occurs, in both tension and compression. Snubbers with activation values less than or equal to 0.02g's are acceptable.

   b. The drag force shall not exceed 3% of the snubber rated load, except for PSA 1/4 the drag force shall not exceed 32.5 lbs.

Test data/computer printouts are documented in Attachment 2.

0-SI-4.6.H-2B, Revision 11, Section 6.0B states: The snubber functional test shall verify that:

1. "As Found"

    a. Corrected activation occurs in both directions of travel at a piston velocity greater than or equal 1 inch/minute and less than or equal 30 inches/minute.

    b. Bleed takes place after activation of the snubber in both the tension and compression directions.

    c. Drag forces do NOT exceed 4.0 percent of the snubber's rated load for snubbers sizes 3 kip to 20 kip and 3.0 percent of the snubber's rated load for snubber sizes 30 kip or greater.

2. "As Left"

    a. Corrected activation occurs in both directions of travel at a piston velocity greater than or equal 5 inches/minute and less than or equal 20 inches/minute.

    b. Corrected bleed takes place after activation of the snubber in both tension and compression and shall be within the ranges shown in Appendix C of the procedurefor each size of snubber.

    c. Drag forces do NOT exceed 2.0 percent of the snubber's rated load.

Test data/computer printouts are documented in Attachment 2 of the procedure.

0-SI-4.6.H-2C, Revision 5, Section 6.0 states: Responses which fail to meet the As Found Acceptance Criteria require immediate notification of the Snubber Engineer/SE designee at the time of failure.

1. "As Found"

    a. Activation shall occur in both directions of travel at a piston velocity greater than or equal 6 inches/minute and less than or equal 25 inches/minute.

    b. Bleed shall take place after activation of the snubber, in both tension and compression.

    c. Drag forces shall be less than or equal to 15,000 pounds.

    d. Activation, bleed, or drag force acceptance criteria may be other than that described in the steps above, if approved by Site Engineering on Attachment 5 of the procedure.

2. "As Left"

   a. Activation shall occur in both directions of travel at a piston velocity greater than or equal 6 inches/minute and less than or equal 25 inches/minute.

   b. Bleed shall take place after activation of the snubber, in both tension and compression and be greater than or equal 1 inch/minute and less than or equal 10 inches/minute.

   c. Drag force shall be less than or equal to 15,000 pounds.

   d. Activation, bleed, or drag force acceptance criteria may be other than that described in the steps above, if approved by Site Engineering on Attachment 5 of the procedure.

   e. There shall be no loose or missing fasteners for attachment of the "As Found" dynamic restraint(s) to the component or the anchorage. Otherwise, complete Attachment 6 of the procedure.

   f. The stroke setting shall be within the limits shown on the design drawing.

0-SI-4.6.H-2E, Revision 8, Section 6.0B states: The snubber functional test shall verify that:

1. "As Found"

   a. Activation occurs in both directions of travel at a piston velocity greater than or equal 6 inches/minute and less than or equal 25 inches/minute.

   b. Bleed takes place after activation of the snubber, in both tension and compression directions.

   c. Drag force does not exceed 15,000 pounds.

2. "As Left"

   a. Activation occurs in both directions of travel at a piston velocity greater than or equal 6 inches/minute and less than or equal 25 inches/minute.

   b. Bleed takes place after activation of the snubber, in both tension and compression, and is greater than 0.24 inch/minute and less than 1.18 inches/minute.

   c. Drag force does not exceed 15,000 pounds.

Test data/computer printouts are documented in Attachment 2 of the procedure.

Breakaway force is a test parameter printed in the test data for drag test performed, normally less than the maximum drag force.

0-SI-4.6.H-2F, Revision 1, Section 6.0B states: The snubber functional test shall verify that:

1. "As Found"

   a. Activation shall occur in both directions of travel at lockup velocity greater than or equal 4.72 inches/minute and less than or equal 14.17 inches/minute.

   b. Bleed rate shall take place after activation in tension and compression direction and shall be between 0.47 inch/minute and 4.72 inches/minute at full rated load plus/minus 5 percent.

2. "As Left"

   a. Activation shall occur in both directions of travel at lockup velocity greater than or equal 4.72 inches/minute and less than or equal 14.17 inches/minute.

   b. Bleed rate shall take place after activation in tension and compression direction and shall be between 0.47 inch/minute and 4.72 inches/minute at full rated load plus/minus 5 percent.

   c. Drag force shall be less than or equal 2.0 percent of rated load of the snubber, or 20 lbs. (whichever is greater).

Above parameters are based on ambient temperature between 65 and 75 degrees F.

Test data/computer printouts are documented in Attachment 2 of the procedure.

OM Part 4 Section 3.2.1.1 b) activation is within the specified range of velocity or acceleration in both tension and compression

Acceleration tests performed on mechanical snubbers are in accordance with

0-SI-4.6.H-2A. LOCKUP and BLEED TEST performed on hydraulic type snubbers are in accordance with 0-SI-4.6.H-2B, 0 SI 4.6.H 2C, 0-SI-4.6.H-2E and 0-SI-4.6.H-2F. Acceleration Test, Lockup and Bleed Test data/computer printouts are graphs of Velocity (ipm), Time (seconds) and Force (lbs).

0-SI-4.6.H-2A, Section 6.0B states: The snubber functional test shall verify that:

1. "As Found"

   Activation (restraining action) occurs, in both tension and compression. Snubbers with activation values less than or equal to 0.04 g's are acceptable. The measured value shall be rounded to the second decimal place. Activation values greater than 0.04 g's shall be considered as a failure (inoperable snubber), require a failure analysis, and be evaluated for additional scope or expansion testing.

2. "As Left"

   Activation (restraining action) occurs, in both tension and compression. Snubbers with activation values less than or equal to 0.02g's are acceptable.

Test data/computer printouts are documented in Attachment 2 of the procedure.

0-SI-4.6.H-2B, Section 6.0B states: The snubber functional test shall verify that:

1. "As Found"

   Corrected activation occurs in both directions of travel at a piston velocity greater than or equal 1 inch/minute and less than or equal 30 inches/minute.

2. "As Left"

   Corrected activation occurs in both directions of travel at a piston velocity greater than or equal 5 inches/minute and less than or equal 20 inches/minute.

Test data/computer printouts are documented in Attachment 2 of the procedure.

0-SI-4.6.H-2C, Section 6.0 states: Responses which fail to meet the As-Found Acceptance Criteria require immediate notification of the Snubber Engineer/SE designee at the time of failure.

1. "As Found"

   a. Activation shall occur in both directions of travel at a piston velocity greater than or equal 6 inches/minute and less than or equal 25 inches/minute.

   b. Bleed shall take place after activation of the snubber, in both tension and compression.

   c. Activation, bleed, or drag force acceptance criteria may be other than that described in the steps above, if approved by Site Engineering on Attachment 5 of the procedure.

2. "As Left"

   a. Activation shall occur in both directions of travel at a piston velocity greater than or equal 6 inches/minute and less than or equal 25 inches/minute.

   b. Bleed shall take place after activation of the snubber, in both tension and compression and be greater than or equal 1 inch/minute and less than or equal 10 inches/minute.

   c. Activation, bleed, or drag force acceptance criteria may be other than that described in the steps above, if approved by Site Engineering on Attachment 5 of the procedure.

Test data/computer printouts are documented in Attachment 2 of the procedure.

0-SI-4.6.H-2E, Section 6.0B states: The snubber functional test shall verify that:

1. "As Found"

   Activation occurs in both directions of travel at a piston velocity greater than or equal 6 inches/minute and less than or equal 25 inches/minute.

2. "As Left"

   Activation occurs in both directions of travel at a piston velocity greater than or equal 6 inches/minute and less than or equal 25 inches/minute.

Test data/computer printouts are documented in Attachment 2 of the procedure.

0-SI-4.6.H-2F, Section 6.0B states: The snubber functional test shall verify that:

1. "As Found"

   a. Activation shall occur in both directions of travel at lockup velocity greater than or equal 4.72 inches/minute and less than or equal 14.17 inches/minute.

   b. Bleed rate shall take place after activation in tension and compression direction and shall be between 0.47 inch/minute and 4.72 inches/minute at full rated load plus/minus 5 percent.

2. "As Left"

   a. Activation shall occur in both directions of travel at lockup velocity greater than or equal 4.72 inches/minute and less than or equal 14.17 inches/minute.

   b. Bleed rate shall take place after activation in tension and compression direction and shall be between 0.47 inch/minute and 4.72 inches/minute at full rated load plus/minus 5 percent.

Above parameters are based on ambient temperature between 65 and 75 degrees Fahrenheit.

Test data/computer printouts are documented in Attachment 2 of the procedure.

OM Part 4, Section 3.2.1.1 c) - release rate, where applicable, is within the specified range in tension and compression. For units specifically required not to displace under continuous load, the ability of the snubber to withstand load without displacement shall be demonstrated.

0-SI-4.6.H-2B, Section 6.0B states: The snubber functional test shall verify that:

1. "As Found"

   Bleed takes place after activation of the snubber in both the tension and compression directions.

2. "As Left"

   Corrected bleed takes place after activation of the snubber in both tension and compression and shall be within the ranges shown in Appendix C of the procedure for each size of snubber.

Test data BLEED (RELEASE) Rate are recorded in Attachment 2 of the procedure.

0-SI-4.6.H-2E, Section 6.0B states: The snubber functional test shall verify that:

1. "As Found"

   Bleed takes place after activation of the snubber, in both tension and compression directions.

2. "As Left"

   Bleed takes place after activation of the snubber, in both tension and compression, and is greater than 0.24 inch/minute and less than 1.18 inches/minute.

Test data BLEED (RELEASE) Rate are recorded in Attachment 2 of the procedure.

Snubber specifically required not to displace under continuous load are addressed in TSR 3.7.4.2.

OM Part 4, Section 3.2.1.2, - Operability Test Loads - Snubbers shall be tested at a load sufficient to verify the operating parameters specified in paragraph 3.2.1.1. Testing at less than rated load must be correlated to operability parameters at rated load.

Test Load parameters are built into the Snubber Test Machine Program and are listed in the applicable Appendixes of 0-TI-398 as follows:

0-TI-398 Appendix B, Section 3.0 provides test parameters in the snubber test machine program for Bergen-Paterson, Anchor Darling, or Fronek Hydraulic snubbers. Test Loads are in the snubber test machine program. These Test Loads are 80 percent of rated load for snubber sizes HSSA -3, -10, -20, -30, ADH/FRONEK -20, -30, -50, -70, and -130.

Lisega Torus Dynamic Restraints are functionally tested using the Lisega Surrogate snubber in accordance with 0-SI-4.6.H-2E. The test load in the snubber test machine program is 44.9 kip nominal value that is correlated to the 100 kip test load used in factory testing. Test data/results are recorded in Attachment 2 of the SI. Lisega Torus Dynamic Restraints may also be functionally tested by the manufacturer using a 100 kip test load prior to installation. Test data/results are recorded in Attachment 2 of the SI.

0-TI-398 Appendix E, Section 6.0, provides test parameters in the snubber test machine program for Pacific Scientific Company (PSA) Mechanical Snubbers, Test Load parameters in the snubber test machine program are 60 percent of rated load for PSA sizes 1/4, 1/2, and 3, and 10 and 50 percent of rated load for PSA sizes 1, 35, and 100.

OM Part 4, Section 3.2.1.3, Qualitative Testing. Qualitative testing may be used in lieu of quantitative measurements in meeting the requirements of paragraph 3.2.1.1, provided adequate justification can be presented and is acceptable to the regulatory authority having jurisdiction over the facility. In those cases, the Owner shall obtain sufficient data, based upon service history or life cycle testing, to justify the ability of the parameter in question to be within specifications over the life of the snubber (e.g., demonstrate that activation takes place without measurement of the activation level). A test report shall be available for each snubber exempted from an inservice quantitative test requirement. The test report must verify that the parameter was within specifications to allow exemption of the snubber from quantitative testing of the parameter.

0-TI-398 has been revised to remove the "push-pull" functional testing of mechanical PSA snubbers.

0-TI-398, Section 7.17.2, Functional Testing of PSA Mechanical Snubbers states:

A. BFN, Unit 2 Technical Requirements require drag force measurements and activation verifications.

B. Mechanical snubber functional testing is performed to verify two characteristics, activation and drag force. The limit for acceleration is not to exceed 0.02 g's. Pacific Scientific Company (PSC) performed qualification tests on new snubbers and performed tests on snubbers that have been in extended plant service to verify the activation levels at various loads. PSC concluded that there is no significant change in activation value at any level of rated load of the snubber.

C. Performing a test for activation of PSA snubbers requires a specialized test machine. BFN has a computer controlled API/Barker STB-200 snubber test bench. The test bench is capable of testing any size PSA snubber and most medium and small bore hydraulic snubbers. The software performs four basic functions:

1. Operator interface
2. Machine control
3. Data acquisition and conversion
4. Data analysis and presentation

Test results are presented in the form of a graph with maximum and average test values.

OM Part 4, Section 3.2.2, Inservice Operability Testing Frequency. Testing shall take place at least every refueling outage using a sample of snubbers in the facility.

TSR 3.7.4.2 requires in-place or bench functional testing of a representative sample of 10% of the total of each type of safety-related snubbers. The testing frequency specified is 24 months.

Surveillance Instructions 0-SI-4.6.H-2A, 0-SI-4.6.H-2B, 0-SI-4.6.H-2C, 0-SI-4.6.H 2E, and 0-SI-4.6.H 2F Section 1.3A, Frequency/Conditions state:

This Surveillance Instruction shall be performed each refueling outage and portions of it may be performed to establish operability in accordance with 1-SI-4.6.H-1, 2-SI-4.6.H-1, and 3-SI-4.6.H-1, 'Visual Examination of Hydraulic and Mechanical Snubbers."

Testing of the 10% sample lot of hydraulic and mechanical snubbers takes place every 24 months/at each scheduled unit refueling outage in accordance with the TSR 3.7.4.2 and the applicable SI.

OM Part 4, Section 3.2.3, Inservice Operability Testing Sample Plans:

The inservice testing sample shall be selected using one of the three sample plans (a comparison of sampling plans is contained in Appendix C):

(a) 10% testing plan

(b) 37 testing plan

(c) 55 testing plan

The snubbers of parallel and multiple installations shall be identified and counted individually. All fractional sample sizes shall be rounded up to the next integer.

0-TI-398, Section 7.17, 2nd paragraph of the Functional Test Program Guidelines states:

Functional tests are performed each operating cycle to meet TRM TRM 3.7.4.2 verifying, by sampling 10% of each subgroup of snubber, that the safety-related or quality-related snubbers are operable. For each failure to meet the functional test acceptance criteria an additional 10% of the remaining snubbers in the subgroup shall be tested, until no additional failures occur. In addition to the required sampling, snubbers under service life monitoring and balance-of-plant programs should be addressed. Specific Technical Requirements are given in the appropriate functional testing SI.

2-SI-4.6.H-1, Appendix A is a snubber listing of each individual snubber shown on a pipe support drawing. Each snubber is given a unique identification number and is counted individually as listed in Appendix A.

OM Part 4, Section 3.2.4, Inservice Operability Testing Failure Evaluations

TSR 3.7.4.3 states that: A failure analysis shall be made of each failure to meet the functional test acceptance criteria of TSR 3.7.4.2 to determine the cause of failure. The frequency is once for each discovery of snubber failure to meet functional acceptance criteria.

0-SI-4.6.H-2A, 0-SI-4.6.H-2B, 0-SI-4.6.H-2C, 0-SI-4.6.H 2E, and 0-SI-4.6.H 2F Attachment 3 provides the requirements for performing failure evaluations of failed snubbers. Additionally, 0-TI-398 provides specific guidance for the performance of failure evaluations on hydraulic and mechanical snubbers.

OM Part 4, Section 3.2.4.1, Failure Evaluation Requirements. Snubbers that do not meet the operability testing acceptance criteria in paragraph 3.2.1 shall be evaluated to determine the cause of the failure.

The BFN, Unit 2, TSR 3.7.4.3 mandates that failure analysis be made for each snubber failure to meet the functional test acceptance criteria in TSR 3.7.4.2 or the applicable SIs:

0-SI-4.6.H-2A, 0-SI-4.6.H-2B, 0-SI-4.6.H-2C, 0-SI-4.6.H 2E, and 0-SI-4.6.H 2F state: Evaluation of snubber operability, corrective actions, and selection of other suspect snubbers for verification shall be as specified on Attachment 3 or Attachment 6, as applicable.

For each failure to meet the functional test acceptance criteria, an additional 10% of the remaining snubbers in the subgroup shall be tested, until no additional failures occur. In addition to the required sampling, snubbers under service life monitoring and balance-of-plant programs should be addressed. Specific Technical Requirements are given in the appropriate functional testing SI.

An Engineering Failure Analysis for Inoperable Snubber must be performed or completed using the appropriate data sheets or attachments of the applicable SIs to determine the cause of failure. Results of this analysis shall be used to select snubbers to be tested in an effort to determine the operability of other snubbers with the same failure mode. Selection of snubbers for future testing may also be based on the failure analysis. This evaluation may also be used by Site Engineering when required to perform a supported system/component analysis.

For each failed snubber, a PER is initiated in accordance with NPG-SPP-06.9.1, “Conduct of Testing,” and NPG-SPP-03.1, a Work Order is initiated to replace the snubber (if necessary), perform in place or STB 200 Test Bench functional test. An additional 10% of the remaining snubbers in the subgroup shall be tested, until no additional failures occur. In addition to the required sampling, snubbers under service life monitoring and balance of plant programs should be addressed. Specific Technical Requirements are given in the appropriate functional testing SI.

0-SI-4.6.H-2A, 0-SI-4.6.H-2B, 0-SI-4.6.H-2C, and 0-SI-4.6.H-2E state: For an inoperable snubber(s), within 72 hours, replace or restore inoperable snubbers to an operable status and perform an engineering evaluation on the supported component or system, if the snubber does NOT meet the functional test acceptance criteria of TSR 3.7.4.2. Otherwise, declare the system inoperable and follow the required actions specified in the TRM. The engineering evaluation is to determine if the component or system restrained by the snubber(s) was adversely affected by inoperability of the snubber(s) during the previous operating cycle and ensure that the restrained component or system remains capable of meeting its design function. The engineering evaluation(s) for supported component or system analysis are to be documented on Attachment 4 of the procedure.

0-SI-4.6.H 2F states: For an inoperable snubber(s), an engineering evaluation must be performed to determine if the component or system restrained by the snubber(s) was adversely affected by inoperability of the snubber(s) during the previous operating cycle and ensure that the restrained component or system remains capable of meeting its design function. The engineering evaluation(s) for supported component or system analysis are to be recorded on Attachment 4 of the procedure.

OM Part 4, Section 3.2.4.2, Test Failure Mode Groups. Unacceptable snubber(s) shall be categorized into test failure mode group(s). A test failure mode group(s) shall include all unacceptable snubbers that have a given failure mode, and all other snubbers subject to the same failure mode. The following failure modes shall be used:

(a) Design/manufacturing **(b) Application induced**

(c) Maintenance/repair/installation **(d) Isolated**

(e) Unexplained

For BFN, Unit 2, TSR 3.7.4.4, NOTE states: This testing is independent of the requirements of TSR 3.7.4.3. For any snubber which fails to lockup or fails to move (i.e., frozen in place), evaluate the cause. If caused by manufacturer or design deficiency, perform in place or bench functional test of all snubbers of the same design, subject to the same defect. The functional test acceptance criteria shall be as specified in TSR 3.7.4.2.

In addition, the applicable Surveillance Instructions require an engineering evaluation of the snubber failure, and classification of the snubber failure mode as isolated, location, manufacturing, design, or other. The engineering evaluation includes determination of subsequent testing required, based on the failure mode, which may involve testing of snubbers susceptible to the same failure mode. However, establishment of specific groupings based on failure modes is not performed.

OM Part 4, Section 3.2.4.3, Test Failure Mode Group Boundaries.

Once a test failure mode group has been established, any snubber(s) in that test failure mode group will not be part of the testing groups from which the snubbers originated except as noted in paragraph 3.2.4.4 below. The new test failure mode group will remain as defined until corrective action has been completed.

As stated in response to Section 3.2.4.2 above, establishment of test failure mode groups is not performed.

OM Part 4, Section 3.2.4.4, Snubbers in More Than One Test Failure Mode Group - In the event that a snubber(s) becomes included in more than one test failure mode group, it shall be counted in each failure mode group in which it is unacceptable and shall be subject to the corrective action of each test failure mode group.

As stated in response to Section 3.2.4.2 above, establishment of test failure mode groups is not performed. The corrective action for a snubber subject to multiple failure modes is as determined and documented in the engineering evaluation in accordance with the applicable Surveillance Instruction.

OM Part 4, Section 3.2.5, Inservice Operability Testing Corrective Action and Impact on Continued Testing - Snubbers which have been found unacceptable for the testing acceptance criteria of paragraph 3.2.1.1 shall be subjected to the following corrective actions(s) with its indicated impact on continued testing. Selection of the corrective action shall be governed by the sampling plan which is used.

See discussion for OM Part 4 item 3.2.4.1 above. For each unacceptable or failed snubber, a PER is initiated in accordance with NPG-SPP-06.9.1 and NPG-SPP-03.1, failure analysis performed, Work Order initiated to replace the snubber (if necessary), or STB 200 Test Bench functional test performed on an additional lot equal to 10% of the remaining snubbers of that type. Testing shall continue until no additional inoperable snubbers are found within the subsequent lots or all snubbers of the original test type are tested or all suspect snubbers identified in the failure analysis have been tested, as applicable. The functional test criteria shall be as specified in TSR 3.7.4.2 or the applicable test SIs.

OM Part 4, Section 3.2.6, Inservice Operability Testing Methods.

The following test requirements shall apply:

(a) Testing to be performed on the snubbers in their as found condition to the fullest extent practical regarding the features to be tested

(b) Test methods employed must not alter the condition of the snubber to the extent the results are not representative of the parameters prior to test

(c) Inservice operability testing may be accomplished with the snubber installed in its permanent location by utilizing Owner approved test methods and equipment

(d) The snubbers may be removed and bench tested in accordance Owner approved test procedures. After reinstallation, the snubber shall meet the requirements of paragraph 2.1.1(e)

(e) Where the physical size of the snubber, test equipment limitations, or inaccessibility of location prevent the use of methods in paragraphs (c) and (d) above, the snubber subcomponents shall be examined and tested in accordance with approved procedures. Reassembly of individual components must be in accordance with approved procedures.

(f) Testing methods may be used which measure parameters indirectly or parameters other than those specified if those results can be correlated to the specified parameters through established methods.

For BFN, Unit 2, Operability testing methods for mechanical and hydraulic snubbers are quantitative, in accordance with applicable SIs 0-SI-4.6.H-2A, 0-SI-4.6.H-2B, 0-SI-4.6.H-2C, 0-SI-4.6.H-2E, and 0-SI-4.6.H-2F and TSR 3.7.4.2 requirements and, MPI-0-000-SNB004 for Removing and Reinstalling Snubbers, and MPI-0-000-SNB002 for Hydraulic shock and Sway Arrestor Bergen-Paterson, Anchor/Darling, Fronek Unit Disassembly and Reassembly to meet the requirements (a) through (f) above.

OM Part 4, Section 3.3, Testing Documentation Documents necessary to verify result of the Pre-service and inservice program shall include as a minimum:

(a) Pre-service operability test procedures and results

(b) Inservice operability test procedures and results

(c) Non-conformance results, non-conformance evaluations, and corrective action

TR 3.7.4 documents the required action, completion time and conditions pertaining to the operability, inspection, testing, and acceptance criteria of snubbers at BFN. Surveillance instructions are utilized to implement the requirements of TR 3.7.4. Plant surveillance instructions 0-SI-4.6.H-2A, 0-SI-4.6.H-2B, 0-SI-4.6.H-2C, 0-SI-4.6.H-2E, and 0-SI-4.6.H-2F cover functional testing of all snubbers at BFN. Surveillance instruction 2-SI-4.6.H-1 covers the visual examination of Unit 2 hydraulic and mechanical snubbers. These surveillance instructions document pre-service operability test procedures and results. They also document in-service operability test procedures and results, nonconformance evaluations, and corrective actions. Plant procedure NPG-SPP 03.1 is utilized to document when snubbers are found to be outside of testing acceptance criteria or in a nonconforming condition. Surveillance instructions are included in the work package for the snubber and transmitted to permanent record storage (EDMS) after closure of the work package/work order.

The proposed alternative for snubber visual examination training qualification and documentation is provided by 2-SI-4.6.H-1 Step 7.1.1 [A] through [F]. The visual acuity requirements of IWA-2320 are satisfied.

IWA-2300 addresses qualifications of NDE personnel. The BFN Snubber Program engineer and persons performing the snubber inspections meet the visual requirements described by IWA-2300.

For BFN, Unit 2, 0-SI-4.6.H-2A, 0-SI-4.6.H-2B, 0-SI-4.6.H-2C, 0-SI-4.6.H-2E, and 0-SI-4.6.H-2F provide a means for the control and documentation of all snubber surveillance activities provided in this Surveillance Instruction. Snubber(s) operability tests results, including nonconformance results, nonconformance evaluations, and corrective actions, are documented in the appropriate data sheets or attachments of the applicable SIs listed above. These documents are included in the work package for the tested snubber and transmitted to permanent record storage (EDMS) after closure of the work package/Work Order for entry into the database.

Tennessee Valley Authority
Browns Ferry Nuclear Plant, Unit 2

Relief Request No. 2-ISI-40, Snubbers Inspection and Testing

Relief Request No. 2-ISI-40, Reference L

Browns Ferry Nuclear Plant, Mechanical Preventive Instruction, MPI-0-000-SNB002, "Hydraulic Shock and Sway Arrestor Bergen-Patterson Anchor/Darling and Fronek Unit Disassembly and Reassembly"

Browns Ferry Nuclear Plant

Unit 0

Mechanical Preventive Instruction

MPI-0-000-SNB002

Hydraulic Shock and Sway Arrestor Bergen-Patterson Anchor/Darling and Fronek Unit Disassembly and Reassembly

Revision 0019

Quality Related

Level of Use: Reference Use

Effective Date: 11-20-2009

Responsible Organization: MMG, Mechanical Maintenance

Prepared By: Annie Hackett

Approved By: Randall Webb

Current Revision Description

Pages Affected: 7, 20

Type of Change: Intent

Tracking Number: 020

Added requirement to utilize the gland packing tool during hydraulic snubber reassembly. This is a Corrective Action for PER 174609.

Table of Contents

Table of Contents (continued)

1.0 PURPOSE/SCOPE/FREQUENCY

1.1 Purpose

This instruction is to serve as a guide in the rebuilding of Bergen-Paterson, Anchor/Darling and Fronek Hydraulic Shock and Sway Arrestors.

1.2 Scope

This instruction will ensure the disassembly, and reassembly of the Bergen-Paterson, Anchor/Darling and Fronek Hydraulic Shock and Sway Arrestors is performed properly.

It covers both Preventive and Corrective Maintenance Practices, which will ensure the shock and sway arrestors remain operable and perform their intended function.

The Bergen-Paterson line of snubbers have been acquired by Anchor/Darling Industries, Inc. and now Anchor/Darling has been acquired by Fronek. Instructions in this procedure for Bergen-Paterson snubbers addressed as HSSA-XXX etc. are also applicable to the corresponding Anchor/Darling and Fronek snubber numbers ADH-XXX etc. identified by the same rated load.

1.3 Frequency

[PER/C] Frequencies are established and maintained in accordance with the plant Preventive Maintenance (PM) Program and Qualification Maintenance Data Sheets (QMDS), as applicable, or as required for maintenance. [PER BFPER940037]

2.0 REFERENCES

MPI-0-000-LUB001, Lubrication of Equipment

MSI-0-000-PRO017, General Torquing Guide

SPP-5.4, Chemical Traffic Control

SPP-6.4, Measuring and Test Equipment

SPP-6.5, Foreign Material Control

SPP-10.3, Verification Program

SPP-10.7, Housekeeping/Temporary Equipment Control

VTD-B209-0240, Installation Instructions for Hydraulic Shock and Sway Arrestors.

2.0 REFERENCES (continued)

VTD-B209-0250, Hydraulic Shock and Sway Arrestor Technical Maintenance Manual with Spare Parts Listings.

BFPER 960004, Pre Service Inspections

0-SI-4.6.H-2B, Functional Testing of Bergen-Paterson, Anchor/Darling or Fronek Hydraulic Snubbers.

0-TI-397, Performance of Maintenance Inspections and Verifications.

3.0 PRECAUTIONS/LIMITATIONS/ALARA

A. Care should be taken when disassembling the reservoir due to high pressure.

B. [PER/C] Parts identified with an asterisk on Attachments 9 and 12 are considered to fall within the scope of the ASME Section XI repair and replacement program. If these parts are required to be replaced, the work package shall be returned to planning to add the applicable ASME Section XI requirements for ANI/ANII review. No further work may progress until the Section XI paperwork has been approved by the ANI/ANII [BFPER 00- 003241-000]

C. Contact RADCON prior to any work in the Radiologically Controlled Area (RCA). RADCON will determine the requirements for a radiation work permit (RWP) and any other RADCON requirements.

D. Measuring Equipment shall be calibrated in accordance with SPP-6.4, Measuring and Test Equipment.

E. Housekeeping shall be maintained in accordance with SPP-10.7, Housekeeping/Temporary Equipment Control.

F. Chemicals used, transported, or contained in the protected area shall be controlled in accordance with SPP-5.4, Chemical Traffic Control.

G. Protective measures must be taken to prevent the entry of foreign material into plant systems and components as described by SPP-6.5, Foreign Material Control.

H. The steps in this instruction may be performed out of sequence to best facilitate the flow of work provided: no prerequisites are violated, completion of subsequent steps are not impaired, and all required inspections and verifications are completed.

3.0 PRECAUTIONS/LIMITATIONS/ALARA (continued)

I. The steps in this instruction may be marked N/A (Not Applicable) with prior concurrence from the Work Supervisor. Concurrence must be documented in the Remarks Section of Attachment 2.

4.0 PREREQUISITES

J. All required replacement parts are on hand prior to performing any maintenance on the snubber(s).

K. All required tools are on hand as listed.

L. The Craftsmen conducting the maintenance have reviewed, and are familiar with this instruction.

M. Notify the unit operator before work begins.

5.0 RECOMMENDED EQUIPMENT

Sockets - 1/2" drive (set), Open/box wrenches (set).

Adapter socket 1/2" to 3/8" drive, 12 pt. 1/4" socket for 3/8" drive.

Allen Wrenches (set).

Adjustable wrench (8" or 12").

Torque wrench (6 ft-lb min. 300 ft-lb max.).

Screwdriver (1/4 or 1/8 blade).

O-ring picks.

Fluid gun, Cutting knife.

Cleaning fluid.

Silicone fluid (SF-1154).

5/16-18 NC threaded rod (8" long) with washer and nut.

Gland packing tool.

6.0 ACCEPTANCE REQUIREMENTS

Snubber shall have no leaks. Rebuilt snubber(s) shall pass functional test criteria in 0-SI-4.6.H-2B.

Date ________

7.0 INSTRUCTIONS STEPS

7.1 Preparation for Maintenance

NOTE
The following step is to be performed by all personnel performing this procedure.

[1] **READ** this procedure. **CONTACT** Work Supervisor for clarification as required.

WHEN procedure is understood, **THEN**

PRINT your name and **SIGN** initials.

Printed Name	Initials

[2] **ENSURE** precautions and Limitations in Section 3.0 have been reviewed. ________

[3] **ENSURE** prerequisites listed in Section 4.0 have been met. ________

[4] **RECORD** WO number:

Work Order # ______________________________ ________

7.2 Basic Design and Technical Information

The unit comprises an externally ported hydraulic cylinder with a flow control valve and filled fluid accumulator. In operation, the piston is free to move unrestricted in either direction, for all piston velocities up to 10" per minute, after which the piston will lock and the unit will act as a rigid strut. This velocity is greater than any operation thermal growth and less than the velocity of any normally anticipated disturbing force.

Therefore, if the unit is checked initially, or when adjustment of the piston stroke is required, care should be taken to avoid sudden force and only a gradual force should be used; otherwise, the piston rod will lock. This will occur in both tension and compression.

If this occurs, reversal of the force will unlock the piston rod again, using a gradual force.

The spring-loaded accumulator, which makes it possible to install the unit at any angle or position, is of sufficient capacity to serve also as a fluid reservoir. Fluid level is indicated by a round plunger (1) extending out through the accumulator housing (2) (Attachment 3).

It is recommended that the stroke reserve not be less than 1" in either direction as indicated by the accumulator plunger (1) (Attachment 3).

The piston rod should be set at the piston rod extension (Attachment 4) dimension as specified on (Attachment 4) of MPI-0-000-SNB004. The piston rod position is measured from the point of rod (3) emergence from the unit head (1) to the small hole (2) in one of the wrench flats (4) (Attachment 4).

A change in piston rod setting is obtained by either pushing or pulling on the rod, as required. Force must be applied slowly in order not to cause closure of the control valve poppet.

Precaution should be taken not to use pipe wrenches on the polished surface of the piston rod (3) (Attachment 4). The wrench flats (4) are provided near the threaded end of the rod (3) (Attachment 4) for this purpose using either open end or box end wrenches.

This procedure can be used to correct unacceptable piston rod surface conditions with the approval of the Snubber Engineer/Designee. If after a visual inspection it is determined that the piston rod (3) (Attachment 4) shows signs of minor scoring or has foreign matter adhering to it (i.e., paint, dirt, corrosion), these areas may be lightly polished with a fine grit Emory cloth/paper or hand buffed with a scotchbrite pad.

7.2 Basic Design and Technical Information (continued)

Proper level is indicated with the end of accumulator plunger (1) (Attachment 3) at or near the "EXT" mark with the piston rod (3) (Attachment 4) fully extended or with the plunger (1) (Attachment 3) end at or near the "RET" mark with the piston rod (3) (Attachment 4) fully retracted. If the accumulator plunger (1) (Attachment 3) is below the "EXT" indication, or one graduation below "RET", then fluid should be added.

The fluid level scale (3) (Attachment 3) has six divisions, each representing 1" of piston movement for the 6" stroke unit. Likewise, for the 12" stroke unit, the fluid level scale is divided into 12 divisions, each representing 1" of piston movement.

To determine exact proper fill level, measure piston rod extension, (Attachment 4) subtract 3/4", and count back one increment for each inch from "RET" mark towards "EXT" mark. The 3/4" dimension is the fixed distance from the drilled hole (2) to the point of rod (3) emergence from the unit head (1) (Attachment 4) as noted previously.

The procedure can also be used to determine rod position by visual inspection.

7.3 Unit Disassembly

NOTES

1) Cleanliness is the most important part of this operation. Cleanliness of parts, work place, and the person who disassembles and reassembles the unit will directly affect its performance. Some of the flow passages are extremely small and the slightest chip, piece of lint, or particle of dirt will prevent the snubber from operating properly.
2) O-ring removal involves working with parts that have close tolerance surface finishes. In critical surface finish areas, scratches, abrasions, dents, and surface deformities cause faulty seals resulting in functional failure of components.
3) [PER/C] Parts identified with an asterisk on Attachments 9 and 12 are considered to fall within the scope of the ASME Section XI repair and replacement program. If these parts are required to be replaced, the work package shall be returned to planning to add the applicable ASME Section XI requirements for ANI/ANII review. [BFPER 00-003241-000]

CAUTIONS

1) Do not use hardened steel, pointed, or sharp-edged tools (knives, screwdrivers, keys) for removal or installation of O-rings or backup rings. Soft metal tools such as brass or aluminum are suitable, and tools of phenolic rod, plastics, or wood can be formed into useful aids to help in ring removal and installation.
2) Tool surfaces must be well rounded, polished, and free of burrs. Check your tools often, especially those surfaces that come in contact with ring grooves and critical polished areas.
3) When O-rings and backup rings are removed from pistons and cylinders, every effort should be made to avoid contact of tools with critical surfaces or parts. When removed, keep old O-rings with their respective components after removal so that they may be used for comparison to new rings.

7.3.1 Preparation Prior to Disassembly

[1] **UNSCREW** piston rod (3) from threaded rod end adaptor (1) (Attachment 5).

[2] Use open end or box end wrench on piston rod (3), rotating adapter (1) or entire unit rather than by rotating piston rod (3) (Attachment 5) to prevent scoring of inner cylinder wall by cast-iron piston rings.

7.3.1 Preparation Prior to Disassembly (continued)

NOTE
If piston rod (3) (Attachment 5) has been marred, use emery cloth/paper or scotch brite pad to remove scoring.

[3] Upon disassembly of strut assemblies, **TAG** major parts and **STORE** bolts and related hardware with assemblies for reuse on reinstallation of unit.

[4] **CLEAN** exterior of unit prior to disassembly with cleaning fluid.

[5] To relieve the spring force and subsequent fluid pressure in the accumulator housing (1), **THREAD** the 5/16-18 NC rod with nut and two flat washers into the indicator rod (5) (Min. 1/2-inch) and **TIGHTEN** until resistance is felt on the indicator plunger (5) (Attachment 7 or 8) indicating compression of the accumulator spring (13a) (Attachment 9) or (1) (Attachment 10).

CAUTION
Caution should be taken to avoid spillage by holding unit over a collection can during the initial bleeding operation. Fluid may cause irritation upon contact with the eyes.

[6] **REMOVE** fluid as follows:

[6.1] **UNBOLT** the four Allen screws (6) holding accumulator (1) to main cylinder (4) (Attachment 8).

[6.2] **UNBOLT** the four Allen screws (6) securing valve manifold flanges onto main cylinder (4) (Attachment 8).

[6.3] **DRAIN** fluid into a suitable container.

OR

[6.4] **BLEED** the unit by unscrewing the 1/4-inch screw (5) (Attachment 9) or (2) (Attachment 10) located in the back plate of the accumulator (1) (Attachment 7 or 8) next to the filler plug, (4) (Attachment 9) or (13) (Attachment 10) using precautions as outlined above.

[6.5] **PUSH** the piston rod (3) (Attachment 7 or 8) in slowly to promote flow of fluid out of bleed hole.

7.3.1 Preparation Prior to Disassembly (continued)

[6.6] **EXTEND** piston rod (3) (Attachment 7 or 8) and **COMPRESS** again slowly, to force fluid out of the main cylinder (4) (Attachment 7 or 8) as well.

7.3.2 Disassembly of Unit

NOTES

1) Since there are two basic configurations, use the outlined procedure of the style being disassembled.
2) Old style - Unit has external tubing between accumulator and valve manifold (Attachment 8).

[1] **DISCONNECT** 1/8" tubing fitting (7) (Attachment 8) and **LOOSEN** end near valve manifold first.

NOTE

Care should be taken to avoid damage to the Allen screws (6) (Attachment 8) or associated parts due to the close proximity of components.

[2] **IF** not previously removed to facilitate fluid removal **THEN**

UNBOLT the four Allen screws (6) holding accumulator (1) to main cylinder (4) (Attachment 8).

[3] **IF** not previously removed to facilitate fluid removal **THEN**

UNBOLT the four Allen screws (6) securing valve manifold flanges onto main cylinder (4) (Attachment 8).

7.3.3 Disassembly of Accumulator

[1] Using a pair of vise grips to secure the tie rod (10 or 10a), **LOOSEN** each of the tie rods (10 or 10a) (Attachment 9) in sequence using open or box end wrenches.

[2] **LOOSEN** these tie rods (10 or 10a) (Attachment 9) so that the end plates (6 and 9) (Attachment 9) will not bind.

7.3.3 Disassembly of Accumulator (continued)

NOTES

1) If the accumulator indicator rod (5) (Attachment 8) was not secured by a 5/16" rod, then the final stages of this loosening operation will involve compressing the end plates (6 and 9) (Attachment 9) with one hand while removing the nuts from the tie rods (10 or 10a) (Attachment 9) with the other. It may be found that due to the pressure exerted by the accumulator spring, (13a) (Attachment 9) two persons should be used during this step.

2) If the 5/16" rod has been used to secure the accumulator piston (14) hand compression of the end plates (6 and 9) will not be necessary, but, in this case, the bolt will have to be untightened to remove the accumulator piston (14) and accumulator spring (13a) (Attachment 9).

[3] **DETACH** the rear end plate (9).

[4] **REMOVE** the accumulator spring (13a), piston (14) and front end plate (6) from accumulator cylinder (7) (Attachment 9).

[5] **REMOVE** old piston packing (15) (Attachment 9), taking care to avoid damage to metal surfaces.

[6] **CLEAN** all metal parts of the accumulator (1) (Attachment 8) and place parts on assembly bench.

7.3.4 Disassembly of Main Cylinder

[1] **UNBOLT** and **REMOVE** external piston rod guide, taking care to avoid damage to the piston rod and bushing surfaces.

[2] **EXAMINE** the piston rod (3) (Attachment 8) for abrasions or nicks prior to this step and **REMOVE** by filing or sanding to prevent damage to the gland (10) (Attachment 9) surfaces in the guide.

[3] Using an Allen wrench, **LOOSEN** the Allen nuts (1) on the back plate (1).

[4] **LOOSEN** each tie rod (8) in sequence using a vise grip to hold the tie rod (8) (Attachment 8).

7.3.4 Disassembly of Main Cylinder (continued)

CAUTION

Caution must be taken to avoid bending of the tie rods (8) (Attachment 8), or stripping of threads during this step.

[5] **REMOVE** O-ring seals (16) from end plates (13), wiper (14) and gland (10) (Attachment 9) from the external piston rod guide.

[6] **CLEAN** all parts and **PLACE** on the assembly bench. **ALLOW** them to air dry.

7.3.5 Disassembly of Control Valve Manifold

NOTES

1) Due to the nature of this component, it should be disassembled in a cleared-off area to avoid loss or incorrect placement of parts during reassembly.
2) The detail drawings Attachment 9 and Attachment 11, should be examined prior to disassembly in order to familiarize personnel with the location of the various moving parts.
3) Valve poppets (4 and 10) (Attachment 9) (6) (Attachment 11) are not interchangeable and must be returned to the same location. By orienting the manifold (5) (Attachment 9) (15) (Attachment 11) prior to disassembly, poppets (4 and 10) (Attachment 9) (6) (Attachment 11) can be placed near their respective hole upon removal and cleaning. The flats on the poppets (4 & 6) (Attachment 9) (6) (Attachment 11) are not identical, and if reversed, would cause malfunctioning of the unit.
4) Pressure relief spring (11) (Attachment 9) or (11) (Attachment 11) and steel balls (12a) (Attachment 9) or (10) (Attachment 11) use extreme care to avoid misplacing these parts. Place in a separate container.

[1] **UNSCREW** the bolts (3) (Attachment 9) (2) (Attachment 11) on the top edge of the manifold (5) (Attachment 9) (15) (Attachment 11).

[2] **PULL** the manifold blocks (5) (Attachment 9) (15) (Attachment 11) off the piping on either side of the manifold.

7.3.5 Disassembly of Control Valve Manifold (continued)

[3] **UNSCREW** the piping connections (4) (Attachment 11) or (7) (Attachment 9) on each side of the manifold (5) (Attachment 9) or (15) (Attachment 11) insuring that the valve poppets (4 and 10) (Attachment 9) or (6) (Attachment 11) are segregated upon removal.

[4] **UNSCREW** the bolt (13) (Attachment 9) (16) (Attachment 11) on the bottom left side using extreme care not to lose the steel balls contained within.

[5] **REMOVE** all O-rings, clean parts, and **PLACE** on assembly bench.

NOTES

1) Care should be taken to insure that backup washer, located in the 1/2" tube fitting, is removed and replaced properly.
2) New style - Unit does not have external tubing (See Attachment 7).

[6] **BLEED** the unit over drip pan as described in Initial Bleeding of Unit, Section 7.3.1[6].

[7] **UNBOLT** four Allen screws (1 & 7) (Attachment 10) holding accumulator to main cylinder.

[8] **UNBOLT** Allen screws (1) (Attachment 11) holding valve manifold (5) (Attachment 9) or (15) (Attachment 11) to rear plate of main cylinder, **PULL** manifold to rear disengaging piping from front plate.

NOTE

Upon removal of the accumulator (1) (Attachment 7) and valve manifold (15) (Attachment 11) note location of O-rings. The machined surfaces where the O-rings are situated must match properly and be undamaged in order to provide proper sealing between components upon reassembly.

[9] For disassembly of the accumulator (1) and main cylinder (4) (Attachment 7) follow Sections 7.3.3 and 7.3.4.

Date ________

7.3.5 Disassembly of Control Valve Manifold (continued)

NOTES
1) Binding of the end plates (6 and 14) (Attachment 10) should be avoided by the rods uniformly due to the spring inside, unless the 5/16" rod is used.
2) For the main cylinder (4) remove external guide by unscrewing nuts on tie rods (6) (Attachment 7).

[10] **REMOVE** seals, **CLEAN** parts, and **PLACE** on assembly bench.

NOTE
The valve manifold, as pictured in Attachment 11 is similar to the old style except for external piping arrangement.

[11] **DISASSEMBLE** the valve manifold following Section 7.3.5 as in the old style unit; however, with the same precautions to avoid loss of the small steel bearings (10) (Attachment 11) which comprise the pressure relief system.

Date ________

7.4 Unit Reassembly

7.4.1 Seal Installation

NOTE

Prior to installation of the new O-rings check first to see that the metal surfaces are free of dust, dirt, and gunk before assembly.

[1] **SELECT** the proper O-ring.

NOTE

A good procedure to use is compare the old O-rings to the new ones to verify sizes and thickness by visual inspection, so be sure to keep old rings with respective component after removal.

[2] **CHECK** the new O-ring to ensure it is free of any scratches or imperfections that may cause improper functioning.

NOTES

1) Be sure the smooth surface of the ring is not damaged during installation by fingernails, tools, or threads.
2) Do not pinch the ring between the base and fitting. Pinching is a leading cause of O-ring failures.
3) Watch for sharp edges on groove shoulder and fitting. Use of tools to ride over these areas, in addition to masking, often helps.

[3] Before any installation, **WET** the ring and bearing surfaces with a light coat of the silicon fluid to be used.

7.4.1 Seal Installation (continued)

CAUTION

[PER/C] The gland packing tool shall be used when transitioning the rod wipe, rod packing and cap assembly over the piston rod during reassembly. [PER 174609]

[4] [PER/C] **ENSURE** the gland packing tool is free from burrs which could damage the rod packing.

[5] **UTILIZE** the gland packing tool when transitioning the rod wipe, rod packing and cap assembly over the piston rod during reassembly. [PER 174609]

NOTES

1) Leak-causing distortion can result if the O-ring is stretched too much. Wetting not only helps eliminate this, but also lets the rings seal naturally in grooves without twists or wrinkles.
2) Remember, use only new silicon fluid as a wetting agent to avoid contamination of the fluid.

[6] **FLOW WASH** the bearing surface with specified silicone fluid and **WIPE** the parts using a lint-free cloth, as necessary.

7.4.1 Seal Installation (continued)

NOTES

1) If, during installation, you must stretch an O-ring or seal, stretch as little as possible and try to stretch uniformly. Once installed, be sure to remove any twists.
2) When pushing a piston or other O-ring containing part into a cylinder or hole, push straight in and not with a turning motion. Turning motion tends to bunch and cut the O-ring eventually causing leakage.
3) Most installations are simply the reverse of removal so keep in mind the procedures used for removing the old O-ring when installing the new ones.
4) Backup rings are used to provide a firm surface against which the O-rings can press to avoid being extruded, under high pressure, into the clearance between the surfaces being sealed. Any movement between the surface with the O-ring extruded would result in a high wear rate leading to eventual failure.

[7] **INSTALL** a backup ring so that it is on the downstream side of the O-ring if used individually, or on each side if the pressure alternates directions.

NOTE

Refer to the valve manifold detail on the drawing in Attachment 9 or 11 to determine correct placement backup ring(s).

[8] **REPLACE** O-rings, seals, and glands using a logical sequence of replacement.

NOTE

Replace seals in one component at a time to avoid confusion. Segregate seals prior to installation and set near component for which they are to be installed.

7.5 Reassembly of Unit

Date ________

7.5 Reassembly of Unit (continued)

NOTES

1) The order of reassembly should be the valve manifold (2) main cylinder (4), and finally the accumulator (1) (Attachments 7 and 8).
2) On all bolted connections, refer to torque specifications of Attachment 14. Line Verifications for torquing during snubber reassembly are performed on Attachment 2. Manifold Tube Connectors which are not equipped with "flats" may be tightened snug tight and the associated signoff on Attachment 2 marked N/A.
3) Torquing of the seal screw should not be performed until after the filling and bleeding process is complete.
4) Minor adjustments may be made to new or existing parts by machining, lapping, or honing to obtain proper fit under the direction of the Cognizant Engineer to correct dimensional tolerances, surface finishes, or alignment. The fit, form, or function of the component must not be altered by the process.
5) Snubber may have mounting screws on the front of the main cylinder, if so torque shall be the same as the mounting screws on the accumulator.
6) For torque values not called out in the procedure, the vendor recommended torque values for Fronek A/DE Socket Head Cap Screws are shown on TABLE 1.

TABLE 1 - Fronek A/DE Socket Head Cap Screw Torque

P/N	135-AX	135-BX	135-CX	135-DX	135-EX	135-FX	135-GX
Thread	#10-32	1/4-28	5/15-24	5/16-18	3/8-24	7/16-20	1/2-20
Torque	50 in-lbs	90 in-lbs	160 in-lbs	160 in-lbs	*160 in-lbs	480 in-lbs	720 in-lbs
* Older Bergen-Paterson Manuals state 300 in-lbs for this screw size. Either value is acceptable for the intended application.							

[1] When assembling the accumulator, the front end plate must be **COMPRESSED**, or the 5/16" rod **TIGHTENED** on the indicator rod in order to reduce the difficulty of assembly.

7.5 Reassembly of Unit (continued)

NOTE

SF 1154 fluid is specified because of its flame resistance and radiation tolerance. SF 1154 shall be used to fill all rebuilt arrestors.

[2] **PUSH** the piston rod (3) (Attachment 7 and 8) to its fully retracted position prior to filling.

[3] After assembly of each component and prior to final assembly of unit, **FILL** the main cylinder (4) (Attachment 7 and 8) using the inlet port in the rear end plate for this purpose.

[4] After filling the main cylinder (4) (Attachment 7 and 8), **ATTACH** the valve manifold (2) (Attachment 7 and 8) and **THEN**

ATTACH accumulator in reverse sequence of disassembly. **LOOSEN** the 5/16" rod on indicator rod, if used.

NOTE

Some model snubbers may contain inaccessible front accumulator mounting cap screws. These cap screws may be torqued using a shop fabricated tool or crowsfoot to establish the specified torque provided the tool is used at a 90° angle to the torque wrench lever to obtain the required torque as specified in MSI-0-000-PRO017.

[5] On the old-style unit, the tube connecting the valve manifold (2) to the main cylinder (4) (Attachment 8) must be **ADJUSTED** to the proper length and the 1/2" tube fitting **TIGHTENED** as part of the reassembly.

[6] **TIGHTEN** tube after torquing tie rods (8 and 9) (Attachment 10) (10 and 10a) (Attachment 9).

7.5 Reassembly of Unit (continued)

> **NOTE**
>
> The new-style unit does not require adjustment of this tube since it is factory-welded to the proper length.

[7] After assembly is complete, **FILL** the accumulator (1) (Attachment 7 and 8) using the filler plug with the proper fluid as noted above (SF-1154) (4) (Attachment 9) (2) (Attachment 10).

[8] **FILL** the accumulator (1) (Attachment 7 & 8) until the indicator rod (1) (Attachment 3) extends beyond the "EXT" setting on the indicator fluid level gauge (3) (Attachment 3).

[9] **BLEED** the unit using the seal screw (5) (Attachment 9) (2) (Attachment 10) next to the filler plug.

[10] **CHECK** the unit by gradually compressing the main piston rod (3) (Attachments 7 and 8).

[11] If it feels spongy, continue bleeding the accumulator (1) (Attachment 7) until a solid pressure can be felt on the main piston rod (3) (Attachments 7 and 8). This may take several strokes.

[12] When the filling and bleeding of the accumulator (1) (Attachments 7 and 8) is complete, **INSTALL** an aluminum spacer ring, such as Lincoln of St. Model No. 63086, on the filler fitting (4) (Attachment 9) (13) (Attachment 10).

[13] **TORQUE** the seal screw (5) as specified on Attachment 14. Verification is to be performed on Attachment 2.

[14] **SET** piston rod (3) (Attachment 7 and 8) at noted extension dimension by either extending or compressing piston rod (3) (Attachment 7 and 8).

[15] **USE** the information provided on the tag attached to the piston rod (3) (Attachment 7 and 8).

[16] **COMPARE** this setting with the detail drawings, and if a discrepancy exists, **CONTACT** the Snubber Engineer or Snubber Specialist.

7.5 Reassembly of Unit (continued)

NOTE
Due to field tolerances, adjustment of the piston rod is acceptable as long as a 1" stroke reserve measured on the fluid level indicator (5) (Attachment 7 and 8) is maintained.

[17] **SET** unit on clean paper for at least one hour to check for leaks.

[18] Allowing at least 10 minutes after cleaning, **EXAMINE** all fittings, joints, and seals for leakage.

[19] **TIGHTEN** pipe threads or reservoir tie rods if loose.

[20] "Tite Joint" tape or equivalent may be used as required on pipe threads.

[21] Do not attempt to tighten cylinder tie rods.

[22] Slight dampness does not require correction. Suppressor will function normally as long as it maintains a reserve of fluid between inspections.

[23] If the suppressor is subject to moisture, high humidity, or vibration, **GREASE** ball bushing fittings provided, as required. Use a high-quality grease, GP-2 for this application.

NOTE

It is recommended that a log be made for each unit noting the following:

- Assembly mark number
- Piston rod extension dimension
- Fluid level indicator setting
- Notation on visible condition of unit

8.0 TESTING

[1] The functional testing and corrective adjustments are to be performed in accordance with 0-SI-4.6.H-2B.

9.0 RETURN TO SERVICE

[1] **CLEAN** entire assembly and **DRY** any accumulations of fluid, especially around fluid-containing joints or fittings.

[2] **GREASE** self-aligning bushings, if provided with grease fittings.

[3] **INSPECT** piston rod for damage or corrosion. Rough surface on the rod may cause the rod seal to leak.

[4] **INSPECT** level of fluid supply, and replenish as necessary. Fluid type is SF 1154 only.

[5] **ENSURE** that all work performed under this procedure is documented in the work performed section of the Work Order.

[6] **COMPLETE** Maintenance documentation in accordance with MMDP-1, Maintenance Management System.

Attachment 1
(Page 1 of 1)

Data Cover Sheet

UNIT ________ Work Order No. ______________________________ Date ______________

Performed by: (List All Persons)

NAME (Print)	NAME (Signature)	INITIALS	DATE

The following work was performed in accordance with the appropriate instructions and met any applicable quality assurance requirements.

____ __________

Foreman / Designee Date

Signature attests that I understand the scope and purpose of this instruction and that, to the best of my knowledge, it was properly performed in accordance with instructions in that: The recording, reduction, and evaluation of data were complete and correct; acceptance criteria were met and dispositioned; and instruction was fully complete except as noted.

____ __________

Cognizant Reviewer Date

Comments: (Comments shall be initialed and dated)

____

____

____

____

____

Attachment 2
(Page 1 of 2)

Disassembly and Reassembly of Bergen-Paterson and Anchor/Darling Hydraulic Shock and Sway Arrestors

UNIT NO. _____ ARRESTOR SERIAL NO. (MFG)________ ARRESTOR SIZE________

	Craftsman	Date
Correct repair parts were installed in snubber.	________	________
New ethylene propylene material Seals and o-rings installed.	________	________
Snubber accumulator to main cylinder aligned properly.	________	________
Snubber reassembled properly and serviced with proper fluid type (SF 1154) and fluid level.	________	________
Snubber has no evidence of leakage following reassembly.	________	________

List Issue Ticket numbers for snubber repair parts and fluid in the Work Order.

Craftsman to initial performance of work and Line Verifier to verify snubber reassembly torque as applicable from Attachment 12.

NOTE

Parts identified with (E) apply to external tubing type snubbers only.

ACCUMULATOR	**CRAFTSMAN**	**M&TE #**	**CAL DUE DATE**	**LINE VERIFIER**	**DATE**
Tie Rods					
Protective Tube Nut					
Mounting Screws					
Filler Plug					
0.25 Tube Fitting (E)					
Seal Screw					
CHECK VALVE	**CRAFTSMAN**	**M&TE #**	**CAL DUE DATE**	**LINE VERIFIER**	**DATE**
Port Plugs					
Relief Valve Plug					
Manifold Connector (E)					
Man. Tube Connector					
Manifold Screw					
0.50 Tube Fittings (E)					
Poppet Stop & Plug					
CYLINDER	**CRAFTSMAN**	**M&TE #**	**CAL DUE DATE**	**LINE VERIFIER**	**DATE**
Tie Rods					
Piston Rod					
ADH Mounting Screws					

ANI/ANII work package review performed if required.

________ ________
Foreman Date

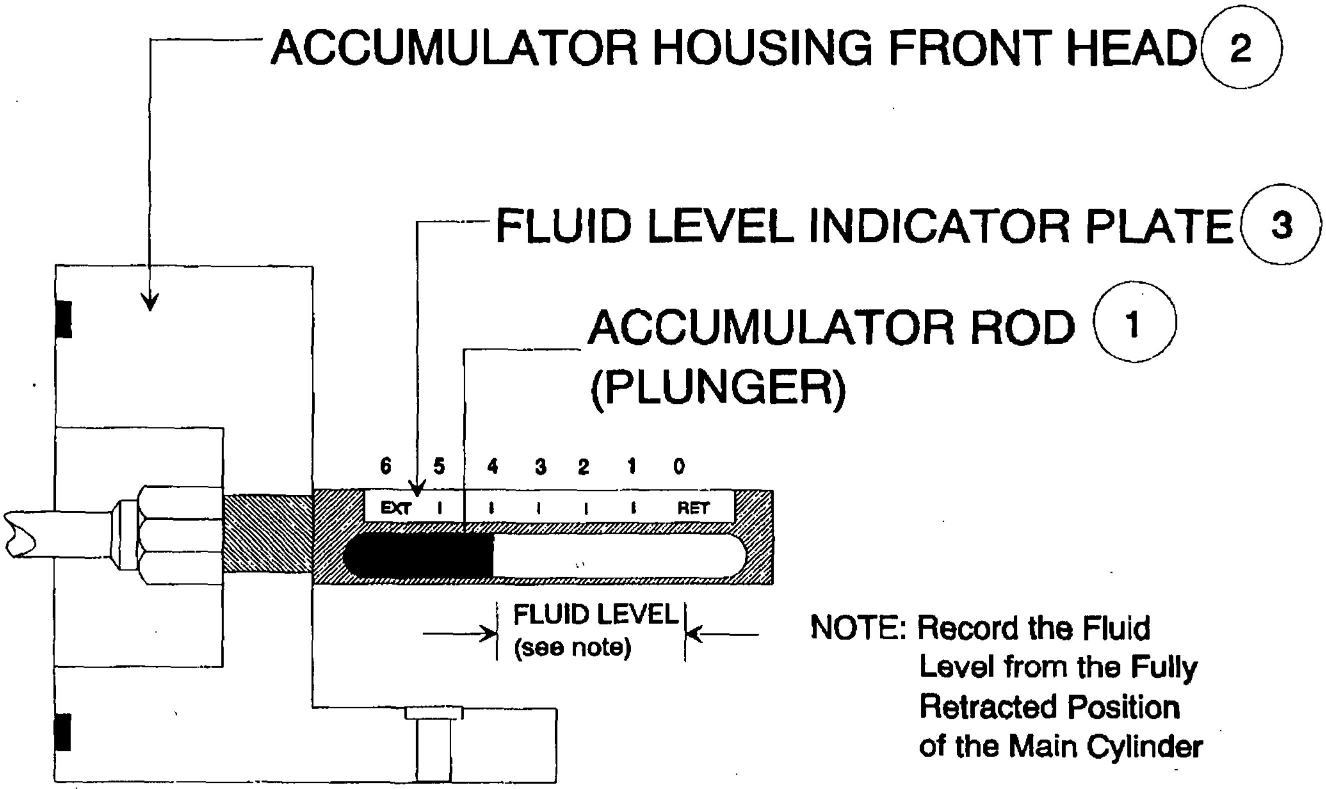
Attachment 2
(Page 2 of 2)

Disassembly and Reassembly of Bergen-Paterson and Anchor/Darling Hydraulic Shock and Sway Arrestors

REMARKS:

Attachment 3
(Page 1 of 1)

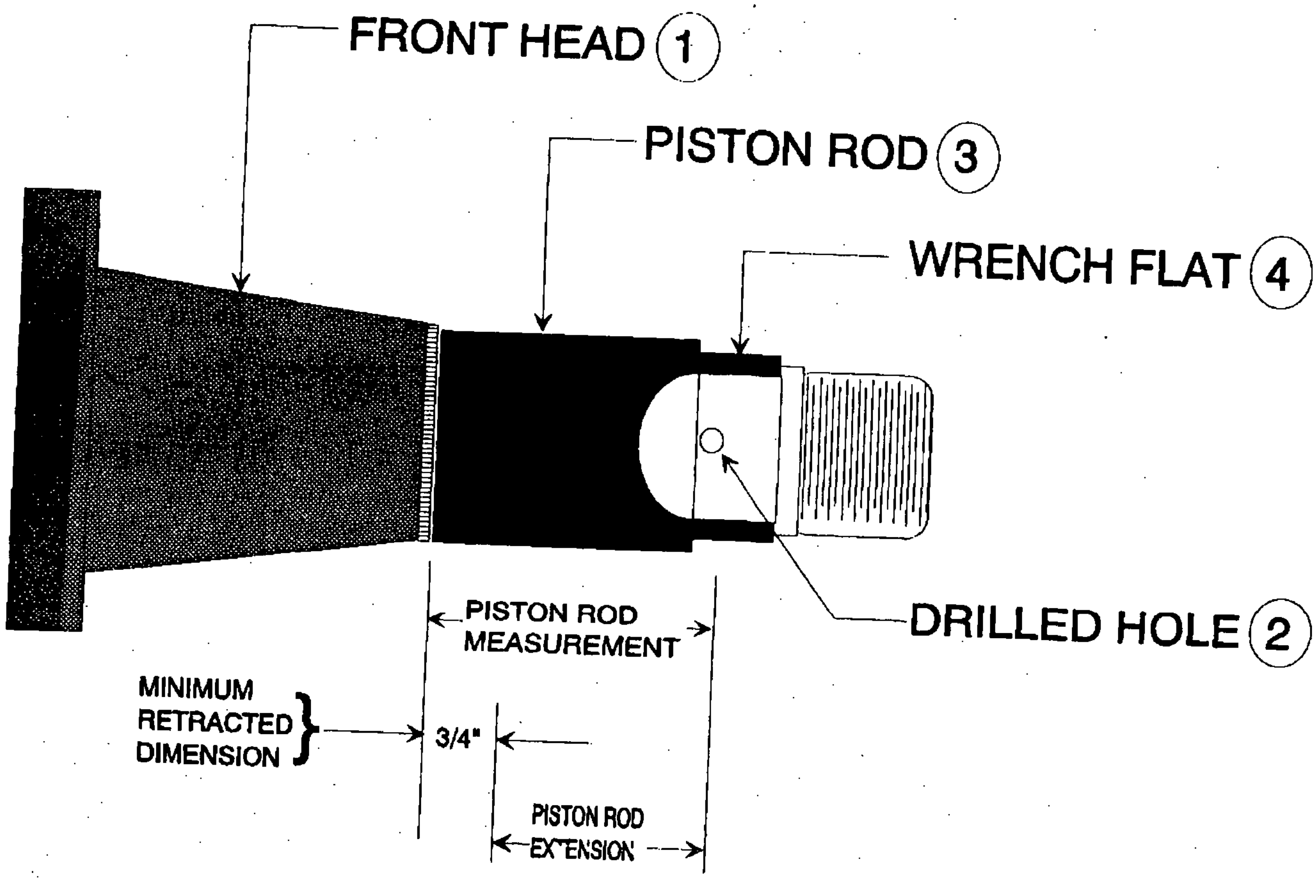
Accumulator Fluid Level



NOTE: Record the Fluid Level from the Fully Retracted Position of the Main Cylinder

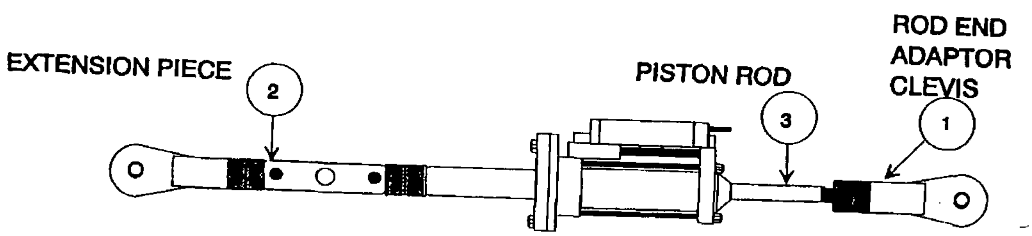
Attachment 4
(Page 1 of 1)

Piston Rod Extension Measurement



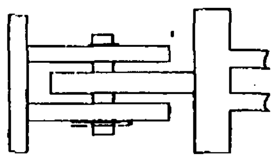
Attachment 5
(Page 1 of 1)

Rod / Accumulator Assembly

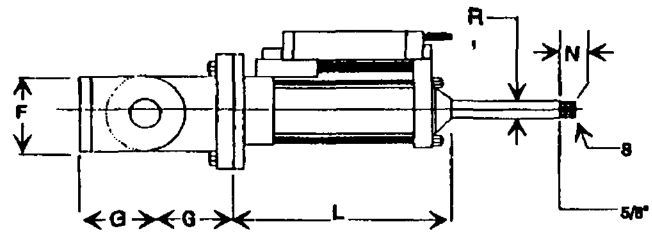


Attachment 6
(Page 1 of 1)

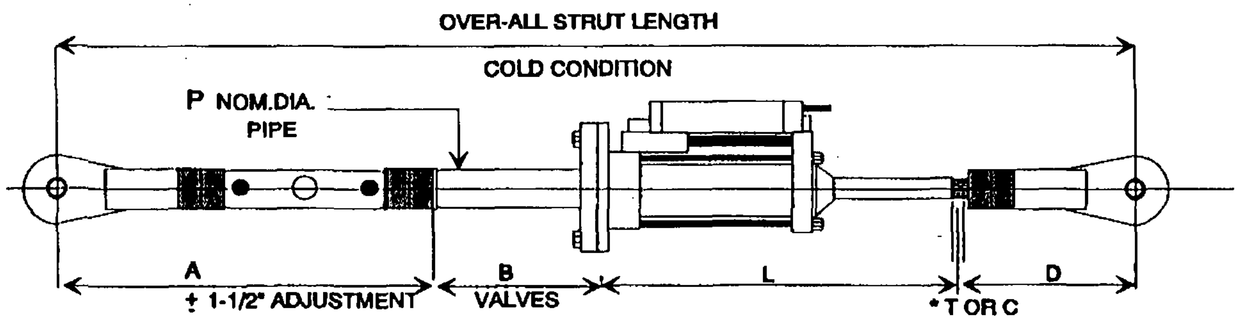
Stroke Setting



MOUNTING "B"
LUG HORIZONTAL



MOUNTING "A"
LUG VERTICAL

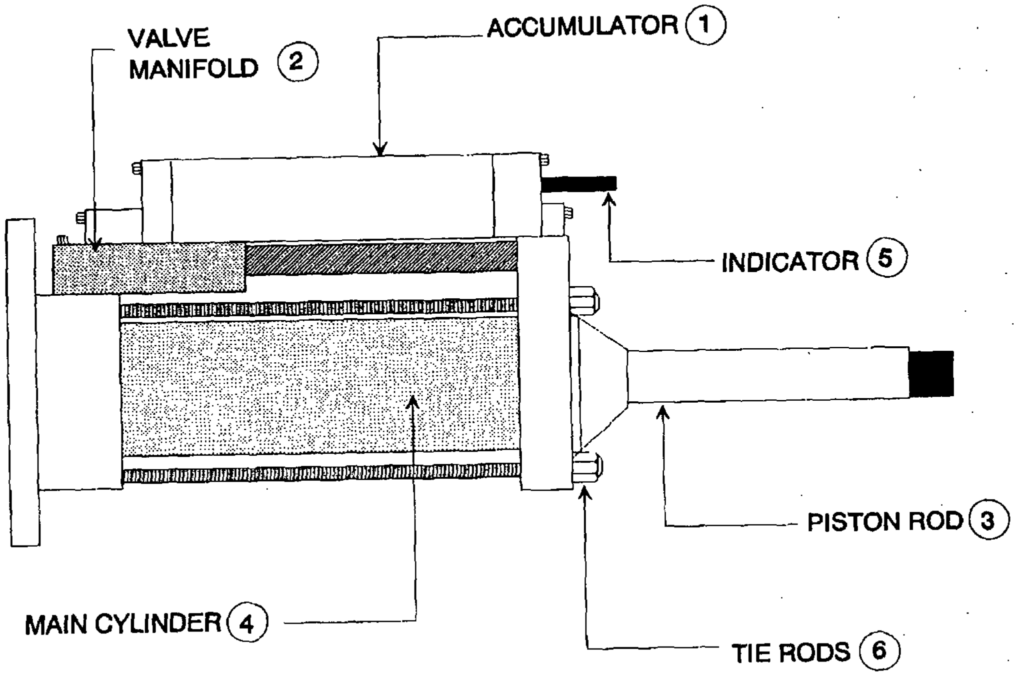


* TO BE SPECIFIED BY CUSTOMER
FOR SETTING SEE DETAIL BELOW.

HSSA * FORCE * **STROKE** * WEIGHT							
SIZE	MAX. FORCE LBS.	BORE	STROKE	L	T or C Fully Retracted	T or C Fully Extended	Hydraulic Unit Wt. (Approx.) Lbs.
			6	16	3/4	6 3/4	37
HSSA-10	10,000	2-1/2	12	22	3/4	12 3/4	45
			18	28	3/4	18 3/4	54
			6	17	3/4	6 3/4	48
HSSA-20	20,000	3-1/4	12	23	3/4	12 3/4	60
			18	29	3/4	18 3/4	72
			6	17 1/2	3/4	6 3/4	70
HSSA-30	30,000	4	12	23 1/2	3/4	12 3/4	87
			18	29 1/2	3/4	18 3/4	104

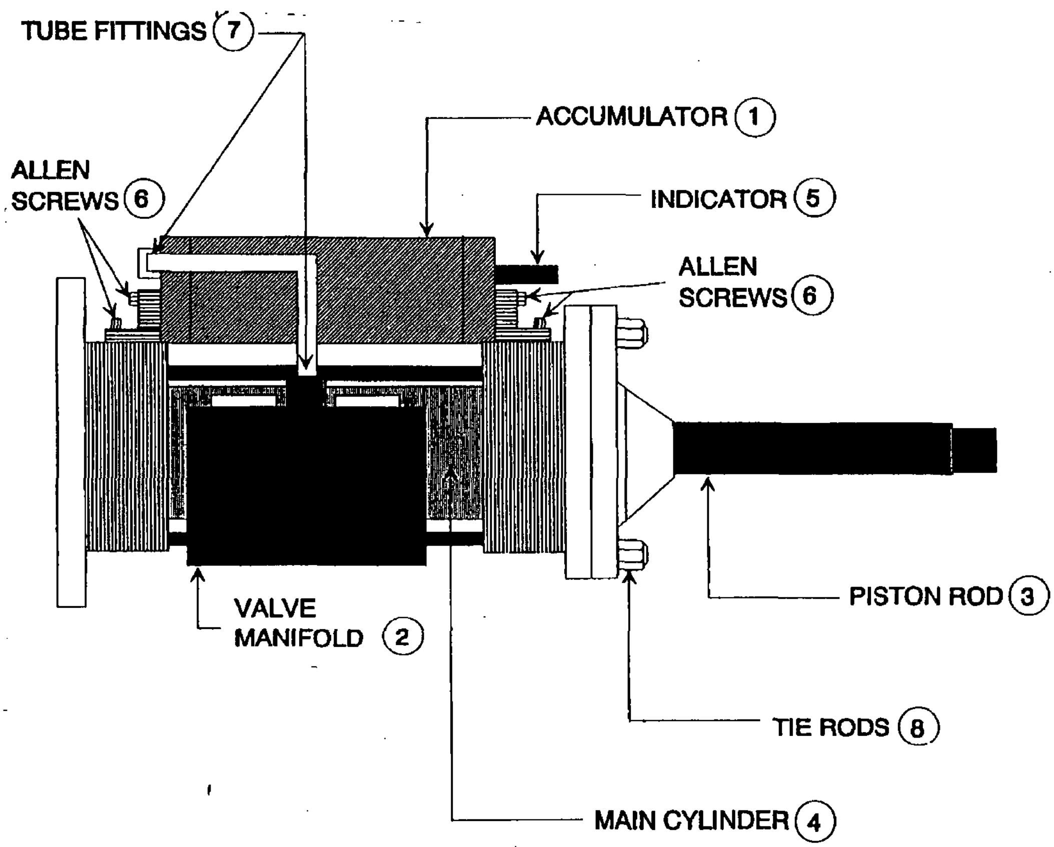
Attachment 7
(Page 1 of 1)

Bergen-Paterson - New Style



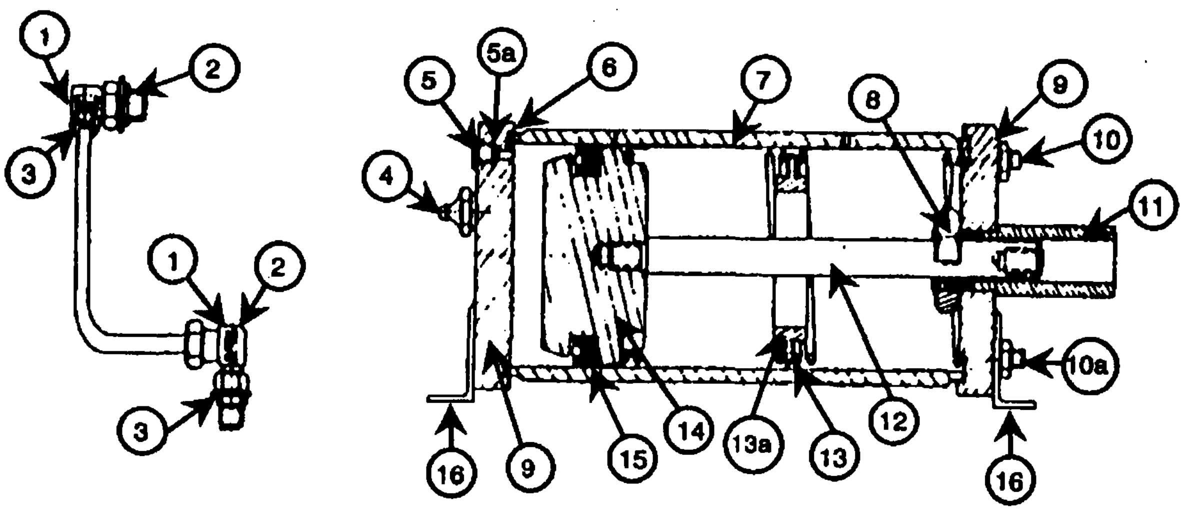
Attachment 8
(Page 1 of 1)

Bergen-Paterson - Old Style



Attachment 9
(Page 1 of 3)

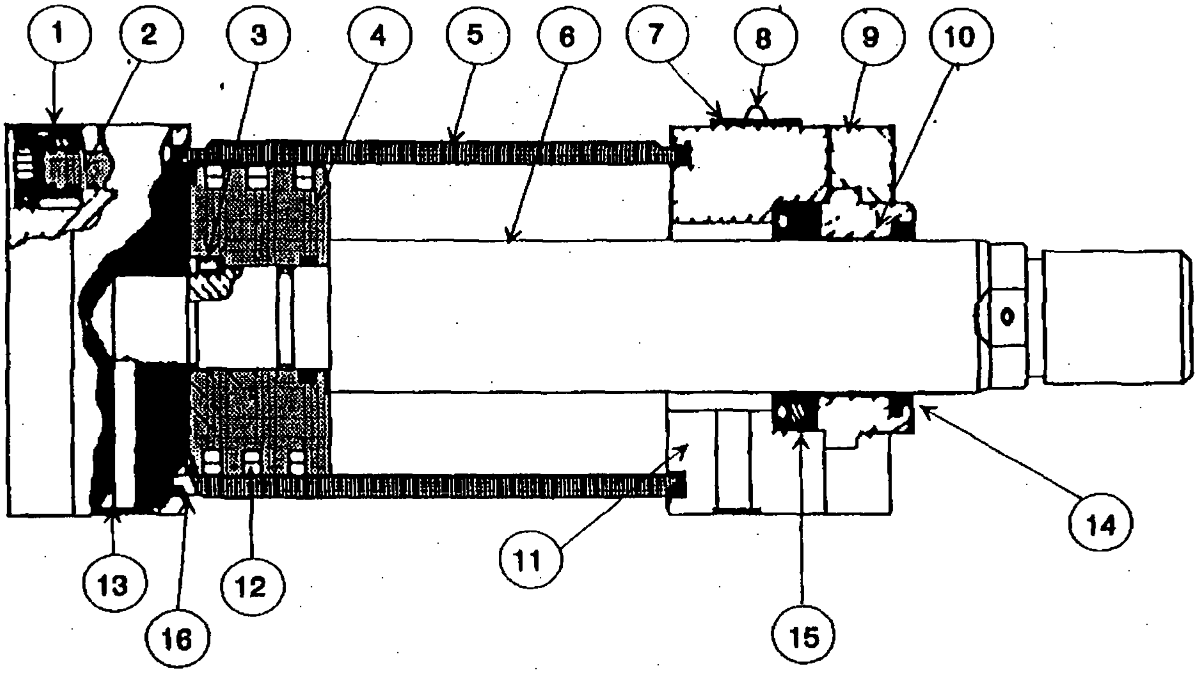
External Pipe Bergen-Paterson Snubber



1	Backup washer
2	O-Ring
3	O-Ring
4	Filler Plug
5	Seal Screw
5a	O-Ring
6	O-Ring
7	Reservoir Tube
8	Lock nut
9	Reservoir Head
10	Tie Rod - Short
10a	Tie Rod - Long
11	Protective Tube
12	Tall Rod
13	Spring Guide
13a	Reservoir Spring
14	Reservoir Piston
15	Piston Packing
16	Mounting Flange

Attachment 9
(Page 2 of 3)

External Pipe Bergen-Paterson Snubber

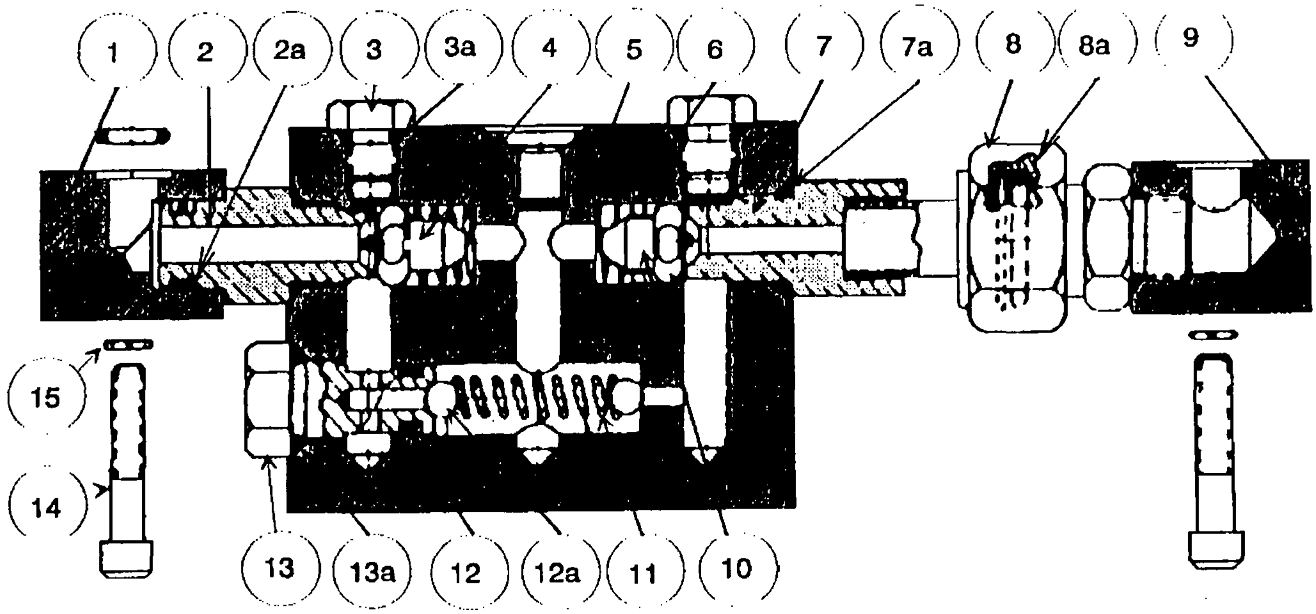


1 *	Tie Rod Nut
2 *	Tie Rod
3 *	Lock Pin
4 *	Piston
5 *	Cylinder Tub
6 *	Piston Rod
7	Name Plate
8	Drive Screw
9 *	Reservoir Head
10 *	Gland
11 *	Head
12 *	Piston Ring
13 *	Cap (End Plate)
14	Rod Wiper
15	Rod Packing
16	O-Ring Seals

* **ASME Section XI parts which require ANI/ANII review of work package when replaced.**

Attachment 9
(Page 3 of 3)

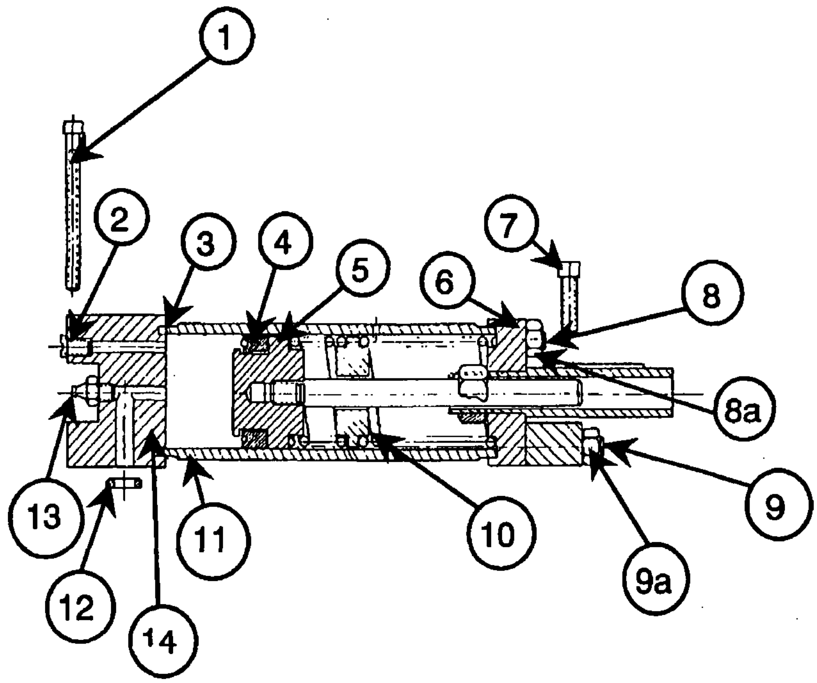
External Pipe Bergen-Paterson Snubber



1.	Rear Manifold Block	8.	1/2" Tube Fitting
2.	Manifold Connector	8a.	Back up Washer
2a.	O-Ring	9.	Front Manifold Block
3.	SAE Port Plug	10.	Popper (Extension)
3a.	O-Ring	11.	Relief Valve Spring
4.	Poppet (Compression)	12.	O-Ring
5.	Flow Control Body	12a	Relief Valve Ball
6.	Popper Spring	13.	Relief Valve Seat
7.	Manifold Tube Connector	13a.	O-Ring
7a.	O-Ring	14.	Manifold Screw
		15.	Lock Washer

Attachment 10
(Page 1 of 2)

Reservoir Assembly



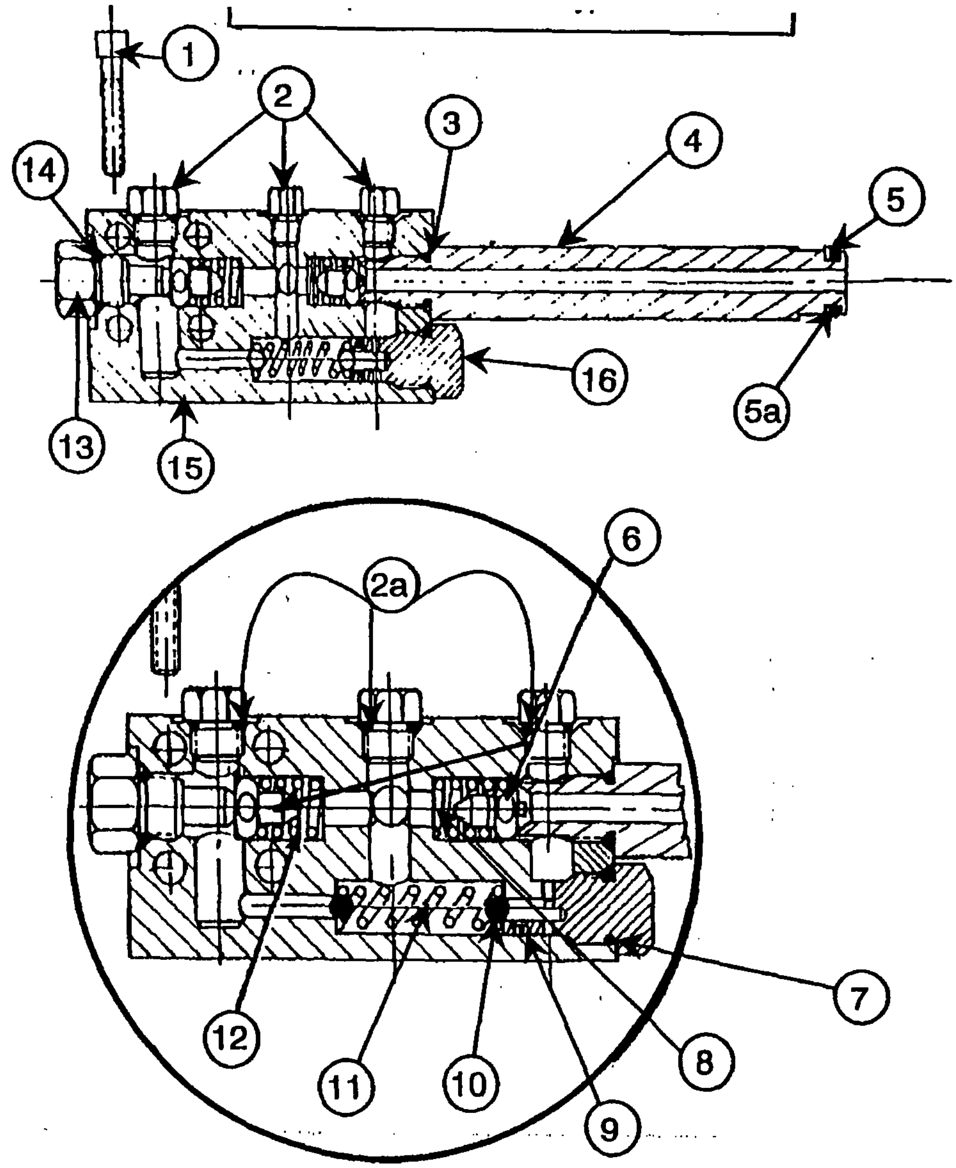
Attachment 10
(Page 2 of 2)

Reservoir Assembly

1	Rear Mounting Screw - Long
2	Seal screw
3	Reservoir Tube
4	Piston Packing
5	Reservoir Piston
6	Reservoir Head
7	Front Mounting Screw - Short
8	Tie Rod - Short
8a	Tie Rod Nut
9	Tie Rod - Long
9a	Tie Rod Nut
10	Spring
11	Cylinder Tube
12	O - Ring
13	Filler Plug - Fitting
14	Rear Plate

Attachment 11
(Page 1 of 2)

Flow Control Assembly (Valve Assembly)



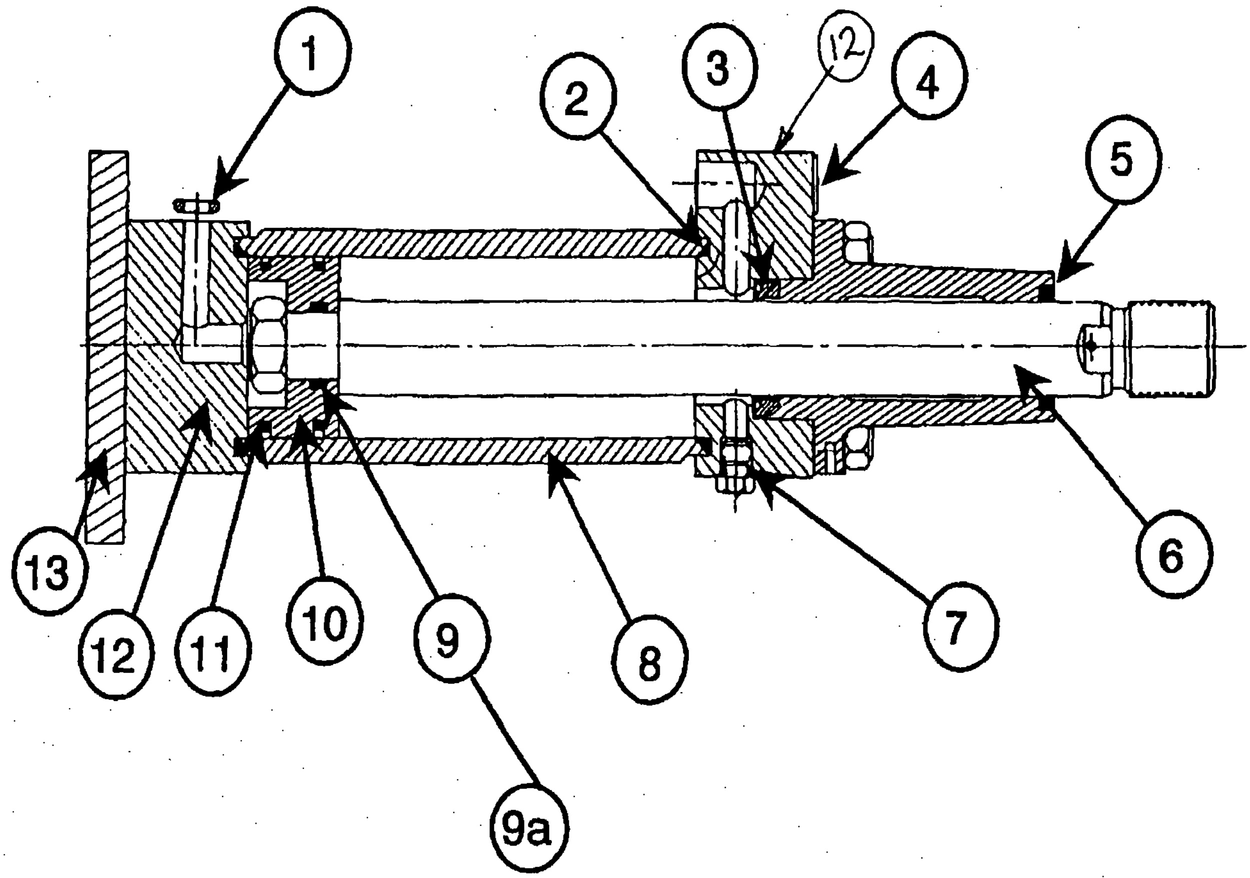
Attachment 11
(Page 2 of 2)

Flow Control Assembly (Valve Assembly)

1	Rear Mounting Screw - Long
2	SAE Port Plug
2a	O-Ring
3	O-Ring
4	Connector Plug
5	O-Ring
5a	Back - Up Washer
6	Poppet (Extension)
7	O-Ring
8	Poppet Spring
9	O-Ring
10	Relief Valve Ball
11	Relief Valve Spring
12	Poppet Spring
13	Poppet Stop and Plug
14	Popper (Compression)
15	Flow Control Body
16	Relief Valve Plug

Attachment 12
(Page 1 of 2)

Main Cylinder Assembly



Attachment 12
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Main Cylinder Assembly

1	O-Ring
2	O-Ring
3	Rod Packing
4	Name Plate
5	Rod Wiper
6 *	Piston Rod
7	O-Ring
8 *	Cylinder Tube
9	O-Ring
9a	O-Ring
10 *	Piston
11 *	Piston Ring
12 *	Cap
13 *	Mounting Flange

* **ASME Section XI parts which require ANI/ANII review of work package when replaced.**

Attachment 13
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Reserve Fluid

SIZE	CYLINDER		ACCUMULATOR		ROD		RESERVE	
	Bore	Area	Bore	Area	Dia.	Area	Cu. In.	Inch
HSSA-3	1-1/2	1.77	2.00	3.14	1	.78	3.1	.99
HSSA-10	2-1/2	4.91	2.50	4.91	1-3/8	1.48	5.21	1.06
HSSA-20	3-1/4	8.29	3.25	8.29	1-3/4	2.40	8.80	1.06
HSSA-30	4	12.57	4.00	12.57	2	3.14	14.10	1.12
HSSA-50	5	19.63	5.00	19.63	2-1/2	4.91	22.00	1.12

Attachment 14
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Torque Specifications Hydraulic Units

	1.5 BORE	2.5 BORE	3.25 BORE	4.00 BORE	5.00 BORE	6.00 BORE	8.00 BORE
	3,000 lbs.	10,000 lbs.	20,000 lbs.	30,000 lbs.	50,000 lbs.	70,000 lbs.	130,000 lbs.
ACCUMULATOR							
TIE RODS	80 IN.- LBS	80 IN.- LBS	180 IN.- LBS	180 IN.- LBS	300 IN.- LBS	300 IN.- LBS	600 IN.- LBS
PROTECTIVE TUBE NUT	18 FT - LBS	18 FT - LBS	18 FT - LBS	18 FT - LBS	18 FT - LBS	18 FT - LBS	18 FT - LBS
PISTON ROD	EPOXY	EPOXY	EPOXY	EPOXY	EPOXY	EPOXY	EPOXY
MOUNTING SCREWS	90 IN.- LBS	90 IN.- LBS	90 IN.- LBS	90 IN.- LBS	90 IN.- LBS	90 IN.- LBS	160 IN.- LBS
FILLER PLUG	50 IN.- LBS	50 IN.- LBS	50 IN.- LBS	50 IN.- LBS	50 IN.- LBS	50 IN.- LBS	50 IN.- LBS
0.25 TUBE FITTING (E)	90 IN.- LBS	90 IN.- LBS	90 IN.- LBS	90 IN.- LBS	90 IN.- LBS	90 IN.- LBS	90 IN.- LBS
SEAL SCREW	50 IN.- LBS	50 IN.- LBS	50 IN.- LBS	50 IN.- LBS	50 IN.- LBS	50 IN.- LBS	50 IN.- LBS
CHECK VALVE							
MAIN CYL HEAD PORT PLUG	20 FT - LBS	20 FT - LBS	20 FT - LBS	20 FT - LBS	20 FT - LBS	20 FT - LBS	40 FT - LBS
RELIEF VALVE PORT PLUG	20 FT - LBS	20 FT - LBS	20 FT - LBS	20 FT - LBS	20 FT - LBS	20 FT - LBS	20 FT - LBS
RELIEF VALVE PLUG	40 FT - LBS	40 FT - LBS	40 FT - LBS	40 FT - LBS	40 FT - LBS	40 FT - LBS	40 FT - LBS
MANIFOLD CONNECTOR (E)	40 FT - LBS	40 FT - LBS	40 FT - LBS	40 FT - LBS	40 FT - LBS	40 FT - LBS	350 FT - LBS
MANIFOLD TUBE CONNECTOR	40 FT - LBS	40 FT - LBS	40 FT - LBS	40 FT - LBS	40 FT - LBS	40 FT - LBS	350 FT - LBS
MANIFOLD SCREW	90 IN.- LBS	90 IN.- LBS	90 IN.- LBS	90 IN.- LBS	90 IN.- LBS	90 IN.- LBS	160 IN.- LBS
0.50 TUBE FITTINGS (E)	90 IN.- LBS	90 IN.- LBS	90 IN.- LBS	90 IN.- LBS	90 IN.- LBS	N/A	N/A
POPPET STOP & PLUG	40 FT - LBS	40 FT - LBS	40 FT - LBS	40 FT - LBS	40 FT - LBS	40 FT - LBS	350 FT - LBS
CYLINDER							
TIE RODS	30 FT - LBS	60 FT - LBS	100 FT - LBS	160 FT - LBS	230 FT - LBS	300 FT - LBS	700 FT -LBS
PISTON ROD	50 FT - LBS	270 FT.- LBS	475 FT.- LBS	750 FT.- LBS	1100 FT.- LBS	1700 FT.- LBS	2000 FT -LBS
(ADH) MOUNTING SCREWS	90 IN.- LBS	90 IN.- LBS	90 IN.- LBS	160 IN.- LBS	40 FT.- LBS	40 FT.- LBS	60 FT.- LBS

NOTE

Parts identified with (E) apply to external tubing type snubbers only.