BSC | **Study Cover Sheet** | QA: N/A

YUCCA MOUNTAIN PROJECT

Preliminary Equipment Qualification Environment Bounding Design Basis Values for YMP ITS Surface and Subsurface Facility SSCs

(Study Title)

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ACRONYMS

BOD	Basis Of Design
DOE	U.S. Department of Energy
EQ	Equipment Qualification
HVAC	Heating Ventilation Air Conditioning
ITS	Important to Safety
ITWI	Important To Waste Isolation
NRC	U.S. Nuclear Regulatory Commission
PDC	Project Design Criteria
QMD	Quality Management Directive
SAR	Safety Analysis Report
SSCs	Structures, Systems, or Components
TID	Total Integrated Dose
YMP	Yucca Mountain Project

1. INTRODUCTION

1.1 PURPOSE AND OBJECTIVES

The purpose of this study is to determine the preliminary values of Yucca Mountain Project (YMP) environmental parameters that are important to design bases for equipment qualification (EQ) of important to safety (ITS) systems, structures, and components (SSCs). These values are considered relative to nuclear industry EQ precedent in order to identify potential matters for additional consideration.

ITS equipment must perform under the environmental conditions existing at their location during normal, off-normal, and event sequence conditions. The environmental parameters important to EQ include temperature and duration, pressure, relative humidity, radiation, chemical spray, water spray, submergence, and seismic. This study compiles the equipment qualification parameters for ITS active mechanical and active electrical SSCs. These SSCs are referred to as EQ SSCs.

EQ applies to these SSCs to ensure:

1. Ability to perform nuclear safety design basis functions under applicable environmental, seismic, and design basis event conditions.

2. Availability, reliability, and component aging management.

The EQ program differentiates between mild and harsh environments, and adjusts the rigor of the program appropriately. The EQ program includes evaluating age–related sensitivity, demonstrating performance under all applicable conditions, and maintaining qualification for the duration of the service life of the EQ SSC. Qualification plans are developed for EQ SSCs, and account for unique materials, environments, functions, and performance requirements.

After determining the expected environments in which each EQ SSC will perform, this study develops conclusions regarding anticipated challenges in adhering to the preferred EQ approach stated in the Project Design Criteria, Sections 4.3.2, 4.3.8, 4.6.5, and the draft Safety Analysis Report (SAR) DOE/RW-0573 Draft E, Section 1.13, Equipment Qualification. These conclusions are based on whether or not each SSC and its environment has precedent in previous U.S. Nuclear Regulatory Commission (NRC) equipment qualification decisions. Seismic qualification precedent is included in developing these conclusions. EQ precedent is considered also for particular pieces of equipment apparently selected in the current design.

These conclusions and the current design options are used to identify potential engineering and licensing impacts associated with EQ of the design.

1.2 SCOPE

The scope of this study includes preparing a compilation of the bounding environmental conditions expected to exist at the locations of PCSA identified EQ SSCs during normal, off normal and event sequence conditions in the following ITS facilities: Aging Pads, Initial Handling Facility, Canister Receipt and Closure Facilities, Receipt Facility, Wet Handling Facility, Emergency Diesel Generator Facility, and Subsurface.

These conditions and the current SSC design options are used to identify potential engineering and licensing impacts associated with EQ of the design.

This engineering study was developed in accordance with EG-PRO-3DP-G04B-00016, Rev. 4, *Engineering Studies*. It is not subject to the quality assurance program requirements, per Criterion 2.1 of the *Quality Management Directive* (QMD) requirements [DIRS 180474], because it is not an activity, as described in the QMD, that is related to the critical characteristics, or quality, of ITS and important to waste isolation (ITWI) barriers. This study will identify potential engineering and licensing concerns for further consideration. The approved engineering study will be submitted to the Records Processing Center as a QA: N/A long-term record.

2. RESULTS AND CONCLUSIONS

A result of this study is the compilation of bounding environmental parameter values shown in Appendix A, Table A-1 for the expected temperature/duration, pressure, relative humidity, radiation, chemical spray, water spray, flooding/submergence for normal, off-normal, and event sequences for YMP EQ SSCs. The environmental parameter bounding values found in Table A-1, updated over time, could be used in equipment qualification activities.

Conclusions are based on adhering to the preferred equipment qualification approach. As stated in the PDC [DIRS 178308] and the draft SAR (Ref. 9), that approach is to utilize proven commercial technology, including facilities and ITS equipment previously qualified, and accepted by the NRC to perform the intended function of the ITS SSCs for YMP. Previously qualified equipment will be used as the first choice.

The method used to develop conclusions regarding potential engineering and licensing impacts associated with EQ of the design are discussed in Section 3.3, Methodology.

One conclusion is that, with one exception, there are no current environmental parameter values that are outside the range of values for which any listed EQ SSC has precedent of qualification acceptance by the NRC. As long as the equipment specified does not depart from previously qualified equipment, EQ-related engineering and licensing impacts are considered minimized.

An exception to this conclusion is situations involving loss of cooling capability or fans to the non-ITS HVAC system in any of the ITS facilities for a significant period of time. In such cases, the EQ SSC equipment in those areas could experience temperatures outside the range of values for which this equipment has precedent of qualification acceptance by the NRC. This potential engineering and licensing impact conclusion is preliminary because event sequence temperature

analysis work for the current ITS facilities has not been finalized. Partial information currently available indicates these temperatures have potential to be at levels that would generate EQ SSC equipment qualification challenges.

A final conclusion is that there are two situations where current design includes apparent selection of a particular piece of equipment that is without precedent of EQ acceptance by the NRC. These are:

1. Drive motors for the transport and emplacement vehicle (TEV)

2. Air pallets as transporters of radioactive material in packages outside of their transportation-ready configuration, that is, when the 10CFR71 container is no longer closed in accordance with its SAR analyzed configuration for safe transport.

The need to qualify these pieces of equipment, rather than using equipment previously qualified and accepted by the NRC, does not adhere to the preferred EQ approach stated in the PDC and the draft SAR.

3. STUDY BASES

3.1 INPUTS

The inputs utilized in this engineering study were obtained from existing design documents describing the YMP Facilities and associated SSCs. The preliminary environmental qualification bounding design basis values listed in Table A-1 are primarily based on design requirements, and in some cases, preliminary analyses.

The indoor temperature and humidity requirements are specified in the *Project Design Criteria Document* [DIRS 178308] and in Calculation 050-M8C-VC00-00400-000-00A (Ref. 7).

The radiation levels reported in Appendix A, Table A-1 are based on values associated with the Classification of Radiation and Contamination Zones of Geologic Repository Operations Area [DIRS 179598]**.** An exception is radiation levels for event sequence conditions, which use a conservative value based on a maximum radiation source term, is discussed in Assumption 3.2.5.

3.2 ASSUMPTIONS

3.2.1 For normal and off-normal conditions, the maximum radiation dose rate has been assumed to be the bounding allowable value within the applicable radiation zones, as a conservative assumption.

3.2.2. The minimum relative humidity value is assumed to be 10%, the minimum summer monthly mean, and the maximum relative humidity value is assumed to be 59%, the maximum winter monthly mean, based on outside relative humidity values in Section 6.1.7 of the PDC [DIRS 178308]. The summer mean is from June and the winter mean is from December.

3.2.3. For event sequence conditions, a dose rate of 4.18E+04 rad/hr at 1 meter distance from the maximum source term, 36 pressurized water reactor (PWR) spent nuclear fuel (SNF) assemblies, was used as a conservative value. See *Direct Radiation Dose Consequence Calculation for Category 1 and 2 Event Sequences* [DIRS 173483].

3.2.4 HVAC Calculations for ITS Cooling for ITS electrical equipment are currently being developed. ITS Cooling results are anticipated to be similar to those calculated in HVAC Calculation 050-M8C-VC00-00400-000-00A. For the battery rooms, the design temperature is assumed to be 77 °F, and for electrical equipment, the maximum and minimum design temperatures are assumed to be: 90 °F (Summer) and 65 °F (Winter).

3.3 METHODOLOGY

Environmental Values

The methodology used to develop Table A-1, which compiles the environmental qualification bounding design basis values for EQ SSCs, was to refer to the existing YMP documents for the current values of environmental condition parameters.

The equipment qualification parameters are developed in accordance with the guidelines contained in Regulatory Guide 1.89, *Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants* [DIRS 102609], and the IEEE Std323-2003, *IEEE Standard for Qualifying Class IE Equipment for Nuclear Power Generating Stations* [DIRS 166907], as appropriate for application of the repository facility. Appendix A, Table A-1 was developed consistent with this guidance

In accordance with IEEE 323-2003, *IEE Standard for Qualifying Class IE Equipment for Nuclear Power Generating Stations* [DIRS 166907], and Regulatory Guide 1.89, *Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants* [DIRS 102609], environmental conditions affecting EQ components must be identified for harsh environments (See Notes 2&3). Environmental conditions vary depending on plant location and operating conditions. The environmental conditions include the normal, off-normal, and event sequences to which the SSC is exposed. This provides bounding environmental conditions in which the equipment must perform its function to control mitigate hazardous situations.

In a nuclear reactor plant, a harsh environment results from a design basis event such as a loss of coolant accident (LOCA), high- energy line break (HELB), or main steam line break (MSLB). These environmental conditions will not likely be experienced at YMP.

In accordance with NRC Regulatory Guides 1.89 and 1.100 [DIRS 102609 and DIRS 110810], ITS Mechanical and Electrical equipment credited with preventing the initiation of or mitigating the consequences of a seismically initiated event must be designed to perform their safety functions during and after the appropriate design basis ground motion. The mechanical and electrical equipment seismic capability must be demonstrated by appropriate testing and analyses. The seismic qualification process must follow the guidelines of Regulatory Guide 1.100, *Seismic Qualification of Electric and Mechanical Equipment for Nuclear Power Plants* [DIRS 110810] and IEEE Std 344-2004, *IEEE Recommended Practice for Seismic Qualification*

of Class IE Equipment for Nuclear Power Generating Stations, [DIRS 176259], as appropriate for the repository seismic design bases.

Four parameters cited in IEEE-323-2003 [DIRS 166907], Section 6.1.5 and not addressed in Table A-1 are Electro Magnetic Compatibility (EMC), Radio Frequency Interference (RFI), Operating Cycles and Electrical Loading/Signals. The first two parameters are addressed in Note 1 of this study. The other 2 parameters are: Operating Cycles and Electrical Loading/Signals. These two parameters and corresponding values will be addressed in their own safety system requirements specifications.

Potential Engineering and Licensing Impacts

The methodology used to identify potential EQ related engineering and licensing impacts was to review the environmental values and current SSC design option selections for departures from equipment previously qualified, and accepted by the NRC. If environmental values for each SSC exceeded values for which that type of equipment had precedent of qualification acceptance by the NRC, it was identified as a potential EQ-related engineering and licensing impact. Similarly, if current designs included apparent selection of a particular piece of equipment, precedent of qualification acceptance by NRC was used to identify potential engineering and licensing impacts associated with equipment qualification of that piece of equipment.

4. SOURCES/REFERENCES

4.1 DOCUMENTS CITED

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2. BSC 2007. *Quality Management Directive.* QA-DIR-010, Rev. 1. Las Vegas, Nevada: Bechtel SAIC Company. ACC: DOC20070330.0001.[DIRS 180474]

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4. BSC 2005. *Repository Twelve Waste Package Segment Thermal Study*. 800-30R-WIS0-00200-000, Rev. 000. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20050620.0005. [DIRS 174226]

5. BSC 2006. Basis of Design for the TAD CanisterBased Repository Design Concept. 000-3DR-MGR0-00300-000-000. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20061023.0002. [DIRS 177636]

6. BSC 2007. *Emergency Diesel Generator Facility-Generator Room Ventilation System Calculation.* 26D-M5C-VN10-00100-000-00A. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20070402-0008.

7. BSC 2007. *WHF Heating and Cooling Load Calculation.* 050-M8C-VC00-00400-000-00A. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20070409.0006

8. BSC (Bechtel SAIC Company2005. *Direct Radiation Dose Consequence Calculation for Category 1 and Categor2 Event Sequences*. 000-00C-WHS0-00600-000-00A. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20050419.0013; ENG.20050803.0012. [DIRS 173483]

9. Yucca Mountain Repository Draft SAR, DOE/RW-0573 Draft E. Bechtel SAIC Company

4.2 CODES, STANDARDS, REGULATIONS, AND PROCEDURES CITED

EG-PRO-3DP-G04B-00016, Rev.4. *Engineering Studies.* Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20070406.0004.

IEEE Std 323-2003. *IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations*. New York, New York: Institute of Electrical and Electronics Engineers. TIC: 255697. [DIRS 166907]

IEEE-Std 344-2004. *IEEE Recommended Practice for Seismic Qualification Class 1E Equipment for Nuclear Power Generating Stations.* New York, New York: Institute of Electrical and Electronics Engineers. TIC: 258050. [DIRS 176259]

Regulatory Guide 1.89, Rev.1, 1984. *Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants.* Washington D.C: U.S. Nuclear Regulatory Commission. TIC: 238593. [DIRS 102609]

Regulatory Guide 1.100, Rev.2, 1988. Seismic Qualification of Electric and Mechanical Equipment for Nuclear Power Plants. Washington D.C: U.S. Nuclear Regulatory Commission. TIC: 4636. [DIRS 110810]

Regulatory Guide 1.180, Rev. 1, 2003. *Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in Safety-Related Instrumentation and Control Systems.* Washington, D.C.: U.S. Nuclear Regulatory Commission. [DIRS 171818]

5. APPENDICES

APPENDIX A
PRELIMINARY EQUIPMENT QUALIFICATION ENVIRONMENT BOUNDING DESIGN VALUES FOR SURFACE AND SUBSURFACE FACILITY SSCs

20 Excel Pages

Table A-1 : Preliminary Equipment Qualification Environment Bounding Design Basis Values For Surface and Subsurface Facility SSC's																					
FACILITY		**NORMAL**							**OFF-NORMAL**							**EVENT SEQUENCES**						
NAME	**System/Equipment.**	**Temp F/dur.**	**Pressure**	**Relative. Humidity**	**Radiation(mrad/hr.)**	**Flooding/ Submergence(Y/N)**	**Water Spray(Y/N)**	**Chem. Spray(Y/N)**	**Temp/dur.**	**Pressure**	**Relative Humidity**	**Rad.(mrad/hr)**	**Flooding/ Submergence(Y/N)**	**Water Spray(Y/N)**	**Chem. Spray(Y/N)**	**Temp/dur.**	**Pressure**	**Relative Humidity**	**Radiation(mrad/hr)**	**Flooding/ Submurgence(Y/N)**	**Water Spray(Y/N)**	**Chem. Spray(Y/N)**
Source		Refs.1 & 7	Refs. 5 & 7 & Note 11	Ref .1	Ref.3& Appx. C	Ref.1 & Note 9	Ref.1 & Note 5	Refs.1 & Note 10	Refs.1 & 7	Refs. 5 & 7 & Note 11	Ref .1	Ref.3& Appx. C	Ref.1 & Note 9	Ref.1 & Note 5	Refs.1 & Note 10	Refs.1& 7	Refs. 5 & 7 & Note 11	Ref .1	Ref.3& Appx. C	Ref.1 & Note 9	Ref.1 & Note 5	Refs.1 & Note 10
1.Aging Pads	Aging Pads/Horizontal Aging Module	2 F-116 F/ Continous	Slightly below atmos @ site location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	2 F-116 F/ Continous	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	2 F-116 F/ Continous	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No
	Aging Handling and Cask Transfer/Horizontal Cask Transfer	2 F-116 F/ Continous	Slightly below atmos @ site location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	2 F-116 F/ Continous	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	2 F-116 F/ Continous	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No
	Aging Handling and Cask Transfer/ Site Transporter	2 F-116 F/ Continous	Slightly below atmos @ site location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	2 F-116 F/ Continous	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	2 F-116 F/ Continous	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No
	Aging Handling and Cask Transfer/ Cask Tractor	2 F-116 F/ Continous	Slightly below atmos @ site location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	2 F-116 F/ Continous	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	2 F-116 F/ Continous	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No
2.Initial Handling Facility (IHF)																						
	Cask Handling. Receipt.Preparation/ Cask Transfer Trolley.	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.0E+02 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	1.0E+02 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	4.18E+04(Ref.8 & Note 7)	No	Yes	No

FACILITY		NORMAL							OFF-NORMAL							EVENT SEQUENCES							
NAME	System/Equipment.	Temp F/dur.	Pressure	Relative. Humidity	Radiation(mrad/hr.)	Flooding/ Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/dur.	Pressure	Relative Humidity	Rad.(mrad/hr)	Flooding/ Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/dur.	Pressure	Relative Humidity	Radiation(mrad/hr)	Flooding/ Submurgence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	
	Cask Handling Waste Pack. Prep/ Waste Pack.Transfer Trolley.	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.0E+02 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	1.0E+02 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	4.18E+04(Ref.8 & Note 7)	No	Yes	No	
	Cask Handling & Waste Pack. Prep/ Empty Waste Package Handling Crane: 300&100 ton Cranes	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.0E+02 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	1.0E+02 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	4.18E+04(Ref.8 & Note 7)	No	Yes	No	
	Cask Handling and Waste Pack. Prep/ Waste Package Handling Crane Lifting Yokes.	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.0E+03 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	1.0E+03 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	4.18E+04(Ref.8 & Note 7)	No	Yes	No	
	Waste Transfer and Canister Transfer /Canister Transfer Machine	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.0E+02 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	1.0E+02 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	4.18E+04(Ref.8 & Note 7)	No	Yes	No	
	Waste Transfer and Canister Transfer/ Crane Lifting Yokes	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.0E+03 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	1.0E+03 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	4.18E+04(Ref.8 & Note 7)	No	Yes	No	

FACILITY		NORMAL							OFF-NORMAL							EVENT SEQUENCES							
NAME	System/Equipment.	Temp F/dur.	Pressure	Relative. Humidity	Radiation(mrad/hr.)	Flooding/ Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/dur.	Pressure	Relative Humidity	Rad.(mrad/hr)	Flooding/ Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/dur.	Pressure	Relative Humidity	Radiation(mrad/hr)	Flooding/ Submurgence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	
	Waste Package Loadout/ Waste Package Transfer Carriage	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	
	Fire Protection System /Fire Suppres./ Manual Isol. Valves leading to the Double-Interlock Preaction Sprinklers	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.5E+01 (Note 6)	No	N/A	No	2 F-116 F/ Continous	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	N/A	No	2 F-116 F/ Continous	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	N/A	No	
	Initial Handling Facility/Interlocks for criticality prevention features	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	ITS Cooling (Ref.1, Sect.4.3.8 & Assump.3.2.4 of study)	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	ITS Cooling (Ref.1,Sect.4.3.8 & Assump.3.2.4 of study)	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	
	Initial Handling Facility/ Interlocks for Perm. Shielding features	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	ITS Cooling (Ref.1, Sect.4.3.8 & Assump.3.2.4 of study)	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	ITS Cooling (Ref.1,Sect.4.3.8 & Assump.3.2.4 of study)	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	
3. Receipt Facility (RF)																				No	Yes	No	

FACILITY		NORMAL							OFF-NORMAL							EVENT SEQUENCES							
NAME	System/Equipment.	Temp F/dur.	Pressure	Relative. Humidity	Radiation(mrad/hr.)	Flooding/ Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/dur.	Pressure	Relative Humidity	Rad.(mrad/hr)	Flooding/ Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/dur.	Pressure	Relative Humidity	Radiation(mrad/hr)	Flooding/ Submurgence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	
	Receipt Facility/Interlocks for criticality prevention features	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	ITS Cooling (Ref.1, Sect.4.3.8 & Assump.3.2.4 of study)	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	**ITS Cooling (Ref.1,Sect.4.3.8 & Assump.3.2.4 of study)**	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	
	Receipt Facility/ Interlocks for Perm. Shielding features	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	ITS Cooling (Ref.1, Sect.4.3.8 & Assump.3.2.4 of study)	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	**ITS Cooling (Ref.1,Sect.4.3.8 & Assump.3.2.4 of study)**	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	
	Surface Nuclear Confin. HVAC/ Portions of the surface nuclear confin. HVAC System that exhaust from areas with a potential for a breach	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	
	Surface Nuclear Confin. HVAC/Cooling of ITS electrical and controls	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	ITS Cooling (Ref.1, Sect.4.3.8 & Assump.3.2.4 of study)	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	**ITS Cooling (Ref.1,Sect.4.3.8 & Assump.3.2.4 of study)**	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	

FACILITY		NORMAL							OFF-NORMAL							EVENT SEQUENCES							
NAME	System/Equipment.	Temp F/dur.	Pressure	Relative. Humidity	Radiation(mrad/hr.)	Flooding/ Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/dur.	Pressure	Relative Humidity	Rad.(mrad/hr)	Flooding/ Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/dur.	Pressure	Relative Humidity	Radiation(mrad/hr)	Flooding/ Submurgence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	
	Cask Handling.Cask Receipt. Csk Preparation/ Cask Handling Crane;200 ton crane	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.0E+02 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	1.0E+02 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	4.18E+04(Ref.8 & Note 7)	No	Yes	No	
	Cask Handling.Cask Receipt. Csk Preparation/ Cask Handling Crane Lifting Yokes	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.0E+03 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	1.0E+03 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	4.18E+04(Ref.8 & Note 7)	No	Yes	No	
	Cask Handling.Cask Receipt. Csk Preparation/ Cask Transfer Trolley	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.0E+02 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	1.0E+02 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	1.0E+02 (Appx. C)	No	Yes	No	
	Waste Transfer and Canister Transfer/ Canister Transfer Machine	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.0E+02 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	1.0E+02 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	4.18E+04(Ref.8 & NOTE 7)	No	Yes	No	
	Waste Transfer and Canister Transf./Lid Lifting Crane: 10 Ton	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.0E+02 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	1.0E+02 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	4.18E+04(Ref.8 & Note 7)	No	Yes	No	

FACILITY		NORMAL							OFF-NORMAL							EVENT SEQUENCES							
NAME	System/Equipment.	Temp F/dur.	Pressure	Relative. Humidity	Radiation(mrad/hr.)	Flooding/ Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/dur.	Pressure	Relative Humidity	Rad.(mrad/hr)	Flooding/ Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/dur.	Pressure	Relative Humidity	Radiation(mrad/hr)	Flooding/ Submurgence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	
	Waste Transfer and Canister Transfer./Crane Lifting Yokes	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.0E+03 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	1.0E+03 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	4.18E+04(Ref.8 & Note 7)	No	Yes	No	
	Surface Nuclear Confin. HVAC/ Surface Nuclear Confin. HVAC/Portions of the surface nuclear confin. HVAC System	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	2.5(Appx. C)	No	Yes	No	ITS Cooling (Ref.1, Sect.4.3.8 & Assump.3.2.4 of study)	Atmos@ Site Location.	59%-10%	2.5 (Appx. C)	No	Yes	No	**ITS Cooling (Ref.1,Sect.4.3.8 & Assump.3.2.4 of study)**	Atmos@ Site Location.	59%-10%	4.18E+04(Ref.8 & Note 7)	No	Yes	No	
	Electrical Power System/ Emergency Direct Current Power	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	ITS Cooling (Ref.1, Sect.4.3.8 & Assump.3.2.4 of study)	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	**ITS Cooling (Ref.1,Sect.4.3.8 & Assump.3.2.4 of study)**	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)				
	Electrical Power System / Emerg. Uninterruptible Power Supply Power	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	ITS Cooling (Ref.1, Sect.4.3.8 & Assump.3.2.4 of study)	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	**ITS Cooling (Ref.1,Sect.4.3.8 & Assump.3.2.4 of study)**	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	

FACILITY		NORMAL							OFF-NORMAL							EVENT SEQUENCES							
NAME	System/Equipment.	Temp F/dur.	Pressure	Relative. Humidity	Radiation(mrad/hr.)	Flooding/ Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/dur.	Pressure	Relative Humidity	Rad.(mrad/hr)	Flooding/ Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/dur.	Pressure	Relative Humidity	Radiation(mrad/hr)	Flooding/ Submurgence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	
	Electrical Support System/ Cable raceway /Portions of Cable Raceway supporting ITS Electrical Power for emerg. Power supply to Nuclear Conf. HVAC System(including MCCs and Load centers)	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	2.5 (Appx. C)	No	Yes	No	ITS Cooling (Ref.1, Sect.4.3.8 & Assump.3.2.4 of study)	Atmos@ Site Location.	59%-10%	2.50E+00	No	Yes	No	**ITS Cooling (Ref.1,Sect.4.3.8 & Assump.3.2.4 of study)**	Atmos@ Site Location.	59%-10%	4.18E+04(Ref.8 & Note 7)	No	Yes	No	
	Electrical Power System/ Emergency Power/Feeders including ITS Loads(including MCCs and Load centers).	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	ITS Cooling (Ref.1, Sect.4.3.8 & Assump.3.2.4 of study)	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	ITS Cooling (Ref.1,Sect.4.3.8 & Assump.3.2.4 of study)	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	
	Electrical Power System/ Emergency Power /Feeders in Duct Banks	**2 F-116 F/ Continous(Note 4)**	atmos @ site location.	59%-10%	None	No	No	No	2 F-116 F/ Continous(Note 4)	Atmos@ Site Location.	59%-10%	None	No	No	No	2 F-116 F/ Continous(Note 4)	Atmos@ Site Location.	59%-10%	None	No	No	No	

FACILITY		NORMAL							OFF-NORMAL							EVENT SEQUENCES							
NAME	System/Equipment.	Temp F/dur.	Pressure	Relative. Humidity	Radiation(mrad/hr.)	Flooding/ Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/dur.	Pressure	Relative Humidity	Rad.(mrad/hr)	Flooding/ Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/dur.	Pressure	Relative Humidity	Radiation(mrad/hr)	Flooding/ Submurgence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	
	Fire Protection System /Fire Suppres./ Manual Isol. Valves leading to the Double-Interlock Preaction Sprinklers	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.5E+01 (Note 6)	No	N/A	No	Note 12	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	N/A	No	Note 12	Atmos@ Site Location.	59%-10%	1.50E+01	No	N/A	No	
4.Emerg. Diesel Gen. Facility (EDGF)																							
	Surface Nuclear Confin. HVAC System /Surface Nuclear Conf. HVAC/ Portions supporting Cooling of ITS Electrical and Controls Equipment(switchgear, DG Controls, Battery room, Mech. room).	120 F-45F/ Continous	Slightly below atmos @ site location.	59%-10%	None	No	Yes	No	120 F-45F/ Continous	Atmos@ Site Location.	59%-10%	None	No	Yes	No	120 F-45F/ Continous	Atmos@ Site Location.	59%-10%	None	No	Yes	No	

FACILITY		NORMAL							OFF-NORMAL							EVENT SEQUENCES						
NAME	System/Equipment.	Temp F/dur.	Pressure	Relative. Humidity	Radiation(mrad/hr.)	Flooding/ Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/ dur.	Pressure	Relative Humidity	Rad.(mrad /hr)	Flooding/ Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/dur.	Pressure	Relative Humidity	Radiation(mrad/hr)	Flooding/ Submurgence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	
	Electrical Power System/Emergency Power/Emergency Diesel Generators(Air systems, Cooling systems, switchgear, and DG Controls)	120 F-45F/ Continous	Slightly below atmos @ site location.	59%-10%	None	No	Yes	No	120 F-45F/ Continous	Atmos@ Site Location.	59%-10%	None	No	Yes	No	120 F-45F/ Continous	Atmos@ Site Location.	59%-10%	None	No	Yes	No	
	Fire Protection System /Fire Suppres./ Manual Isol. Valves leading to the Double-Interlock Preaction Sprinklers	120 F-45F/ Continous	Slightly below atmos @ site location.	59%-10%	None	No	N/A	No	120 F-45F/ Continous	Atmos@ Site Location.	59%-10%	None	No	N/A	No	120 F-45F/Continous	Atmos@ Site Location.	59%-10%	None	No	N/A	No	
5.Wet Handling Facility (WHF)																							
	Cask Handling.Cask Receipt. Cask Preparation/ Cask Handling Crane: 200 ton Crane	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.0E+02 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	1.0E+02 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	4.18E+04(Ref.8 & Note 7)	No	Yes	No	

FACILITY		NORMAL							OFF-NORMAL							EVENT SEQUENCES							
NAME	System/Equipment.	Temp F/dur.	Pressure	Relative. Humidity	Radiation(mrad/hr.)	Flooding/ Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/dur.	Pressure	Relative Humidity	Rad.(mrad/hr)	Flooding/ Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/dur.	Pressure	Relative Humidity	Radiation(mrad/hr)	Flooding/ Submurgence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	
	Cask Handling.Cask Receipt. Cask Preparation/ Cask Handling Crane Lifting Yokes	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.0E+03 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	1.0E+03 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	4.18E+04(Ref.8 & Note 7)	No	Yes	No	
	Cask Handling.Cask Receipt. Csk Preparation/ Entrance Vestibule Crane: 20 Ton	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.0E+02 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	1.0E+02 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	4.18E+04(Ref.8 & Note 7)	No	Yes	No	
	Waste Transfer and Canister Transfer/Can. Trans. Machine	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.0E+02 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	1.0E+02 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	4.18E+04(Ref.8 & Note 7)	No	Yes	No	
	Waste Transfer and Canister Transfer/Crane Lifting Yokes	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.0E+03 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	1.0E+03 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	4.18E+04(Ref.8 & Note 7)	No	Yes	No	

FACILITY		NORMAL							OFF-NORMAL							EVENT SEQUENCES							
NAME	System/Equipment.	Temp F/dur.	Pressure	Relative. Humidity	Radiation(mrad/hr.)	Flooding/ Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/dur.	Pressure	Relative Humidity	Rad.(mrad/hr)	Flooding/ Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/dur.	Pressure	Relative Humidity	Radiation(mrad/hr)	Flooding/ Submurgence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	
	Surface Nuclear Confin. HVAC system/ Portions supporting Cooling of ITS Electrical and Controls Equipment including MCCs and Load centers.	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	ITS Cooling (Ref.1, Sect.4.3.8 & Assump.3.2.4 of study)	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	ITS Cooling (Ref.1,Sect.4.3.8 & Assump.3.2.4 of study)	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	
	Wet Handling Facility/Interlocks for criticality prevention Features	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	ITS Cooling (Ref.1, Sect.4.3.8 & Assump.3.2.4 of study)	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	**ITS Cooling (Ref.1,Sect.4.3.8 & Assump.3.2.4 of study)**	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	
	Wet Handling Facility/Interlocks for Perm. Shielding Features	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	ITS Cooling (Ref.1, Sect.4.3.8 & Assump.3.2.4 of study)	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	**ITS Cooling (Ref.1,Sect.4.3.8 & Assump.3.2.4 of study)**	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	
	Wet Handling Facility/ Pool Level Indicator	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	**Note 12**	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	

FACILITY		NORMAL							OFF-NORMAL							EVENT SEQUENCES							
NAME	System/Equipment.	Temp F/dur.	Pressure	Relative. Humidity	Radiation(mrad/hr.)	Flooding/ Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/dur.	Pressure	Relative Humidity	Rad.(mrad/hr)	Flooding/ Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/dur.	Pressure	Relative Humidity	Radiation(mrad/hr)	Flooding/ Submurgence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	
	Waste Transfer and Fuel Assembly Transfer/ Spent Fuel Transfer Machine	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.0E+02 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	1.0E+02 (Appx. C)	No	Yes	No	**Note 12**	Atmos@ Site Location.	59%-10%	4.18E+04(Ref.8 & NOTE 7)	No	Yes	No	
	Waste Transfer and Fuel Assembly Transfer/ Auxilliary Pool Crane: 10 Ton	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.0E+02 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	1.0E+02 (Appx. C)	No	Yes	No	**Note 12**	Atmos@ Site Location.	59%-10%	4.18E+04(Ref.8 & NOTE 7)	No	Yes	No	
	Waste Transfer and Fuel Assembly Transfer/ Cask Transfer Trolley	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	**Note 12**	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	
	Surface Nuclear Confin. HVAC/Surface Nuclear Confin. HVAC/Portions of the surface nuclear confin. HVAC System supporting the ITS Cooling of equip(including MCCs and Load centers).	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	2.5 (Appx. C)	No	Yes	No	ITS Cooling (Ref.1, Sect.4.3.8 & Assump.3.2.4 of study)	Atmos@ Site Location.	59%-10%	2.5 (Appx. C)	No	Yes	No	**ITS Cooling (Ref.1,Sect.4.3.8 & Assump.3.2.4 of study)**	Atmos@ Site Location.	59%-10%	4.18E+04(Ref.8 & Note 7)	No	Yes	No	

FACILITY		NORMAL							OFF-NORMAL							EVENT SEQUENCES							
NAME	System/Equipment.	Temp F/dur.	Pressure	Relative. Humidity	Radiation(mrad/hr.)	Flooding/ Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/dur.	Pressure	Relative Humidity	Rad.(mrad/hr)	Flooding/ Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/dur.	Pressure	Relative Humidity	Radiation(mrad/hr)	Flooding/ Submurgence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	
	Electrical Power System/ Emergency Power/Feeders up to and including ITS loads(including MCCs and Load centers).	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	ITS Cooling (Ref.1, Sect.4.3.8 & Assump.3.2.4 of study)	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	**ITS Cooling (Ref.1,Sect.4.3.8 & Assump.3.2.4 of study)**	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	
	Electrical Power System/ Emergency Power /Feeders in Duct Banks	**2 F-116 F/ Continous(Note 4)**	atmos @ site location.	59%-10%	None	No	No	No	2 F-116 F/ Continous(Note 4)	Atmos@ Site Location.	59%-10%	None	No	No	No	**2 F-116 F/ Continous(Note 4)**	Atmos@ Site Location.	59%-10%	None	No	No	No	
	Electrical Power System/ Emergency Direct Current Power	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	ITS Cooling (Ref.1, Sect.4.3.8 & Assump.3.2.4 of study)	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	**ITS Cooling (Ref.1,Sect.4.3.8 & Assump.3.2.4 of study)**	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)				
	Electrical Power System / Emerg. Uninterruptible Power Supply Power	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	ITS Cooling (Ref.1, Sect.4.3.8 & Assump.3.2.4 of study)	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	**ITS Cooling (Ref.1,Sect.4.3.8 & Assump.3.2.4 of study)**	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	

FACILITY		NORMAL							OFF-NORMAL							EVENT SEQUENCES							
NAME	System/Equipment.	Temp F/dur.	Pressure	Relative. Humidity	Radiation(mrad/hr.)	Flooding/ Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/dur.	Pressure	Relative Humidity	Rad.(mrad/hr)	Flooding/ Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/dur.	Pressure	Relative Humidity	Radiation(mrad/hr)	Flooding/ Submurgence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	
	Electrical Support System/ Cable raceway /Portions of Cable Raceway supporting ITS Electrical Power for emerg. Power supply to Nuclear Conf. HVAC System	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	2.5 (Appx. C)	No	Yes	No	ITS Cooling (Ref.1, Sect.4.3.8 & Assump.3.2.4 of study)	Atmos@ Site Location.	59%-10%	2.5 (Appx. C)	No	Yes	No	**ITS Cooling (Ref.1,Sect.4.3.8 & Assump.3.2.4 of study)**	Atmos@ Site Location.	59%-10%	4.18E+04(Ref.8 & Note 7)	No	Yes	No	
	Fire Protection System /Fire Suppres./ Manual Isol. Valves leading to the Double-Interlock Preaction Sprinklers	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.5E+01 (Note 6)	No	N/A	No	Note 12	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	N/A	No	**Note 12**	Atmos@ Site Location.	59%-10%	1.50E+01	No	N/A	No	
6. Canister Receipt and Closure Facilities (CRCF 1/2/3)																							

FACILITY		NORMAL							OFF-NORMAL							EVENT SEQUENCES							
NAME	System/Equipment.	Temp F/dur.	Pressure	Relative. Humidity	Radiation(mrad/hr.)	Flooding/ Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/dur.	Pressure	Relative Humidity	Rad.(mrad/hr)	Flooding/ Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/dur.	Pressure	Relative Humidity	Radiation(mrad/hr)	Flooding/ Submurgence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	
	Canister Receipt and Closure Facility (CRCF)/Interlocks for Criticality Prevention Features	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	ITS Cooling (Ref.1, Sect.4.3.8 & Assump.3.2.4 of study)	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	**ITS Cooling (Ref.1,Sect.4.3.8 & Assump.3.2.4 of study)**	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	
	Canister Receipt and Closure Facility (CRCF)/Interlocks for Perm. Shielding Features	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	ITS Cooling (Ref.1, Sect.4.3.8 & Assump.3.2.4 of study)	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	**ITS Cooling (Ref.1,Sect.4.3.8 & Assump.3.2.4 of study)**	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	
	Surface Nuclear Confin. HVAC/Portions supporting Cooling of ITS Electrical and Controls Equipment	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	ITS Cooling (Ref.1, Sect.4.3.8 & Assump.3.2.4 of study)	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	ITS Cooling (Ref.1,Sect.4.3.8 & Assump.3.2.4 of study)	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	
	Cask Handling.Cask Receipt. Cask Preparation/ Cask Handling Cranes: 200 ton Crane	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.0E+02 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	1.0E+02 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	4.18E+04(Ref.8 & Note 7)	No	Yes	No	

FACILITY		NORMAL							OFF-NORMAL							EVENT SEQUENCES						
NAME	System/Equipment.	Temp F/dur.	Pressure	Relative. Humidity	Radiation(mrad/hr.)	Flooding/ Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/dur.	Pressure	Relative Humidity	Rad.(mrad/hr)	Flooding/ Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/dur.	Pressure	Relative Humidity	Radiation(mrad/hr)	Flooding/ Submurgence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	
	Cask Handling.Cask Receipt. Cask Preparation/ Cask Handling Crane Lifting Yokes	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.0E+03 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	1.0E+03 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	4.18E+04(Ref.8 & Note 7)	No	Yes	No	
	Cask Handling.Cask Receipt. Csk Preparation/ Cask Transfer Trolley	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	**Note 12**	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	
	Cask Handling Waste Pack. Prep/ Waste Pack.Transfer Trolley.	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	
	Cask Handling Waste Pack. Prep/ Waste Package Handling Crane: 100 ton	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.0E+02 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	1.0E+02 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	4.18E+04(Ref.8 & NOTE 7)	No	Yes	No	

FACILITY		NORMAL							OFF-NORMAL							EVENT SEQUENCES							
NAME	System/Equipment.	Temp F/dur.	Pressure	Relative. Humidity	Radiation(mrad/hr.)	Flooding/Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/dur.	Pressure	Relative Humidity	Rad.(mrad/hr)	Flooding/Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/dur.	Pressure	Relative Humidity	Radiation(mrad/hr)	Flooding/Submurgence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	
	Surface Nuclear Confin. HVAC/Portions supporting Cooling of ITS Electrical and Controls Equipment	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	ITS Cooling (Ref.1, Sect.4.3.8 & Assump.3.2.4 of study)	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	ITS Cooling (Ref.1,Sect.4.3.8 & Assump.3.2.4 of study)	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	
	Cask Handling and Waste Pack. Prep/ Waste Package Handling Crane Lifting Yokes.	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.0E+03 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	1.0E+03 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	4.18E+04(Ref.8 & Note 7)	No	Yes	No	
	Waste Transfer and Canister Transfer/Can. Trans. Machine	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.0E+02 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	1.0E+02 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	4.18E+04(Ref.8 & Note 7)	No	Yes	No	
	Waste Transfer and Canister Transfer/Crane Lifting Yokes	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.0E+03 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	1.0E+03 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	4.18E+04(Ref.8 & Note 7)	No	Yes	No	
	Waste Package Loadout/Waste Package Transfer Carriage	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	

FACILITY		NORMAL							OFF-NORMAL							EVENT SEQUENCES							
NAME	System/Equipment.	Temp F/dur.	Pressure	Relative. Humidity	Radiation(mrad/hr.)	Flooding/ Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/dur.	Pressure	Relative Humidity	Rad.(mrad/hr)	Flooding/ Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/dur.	Pressure	Relative Humidity	Radiation(mrad/hr)	Flooding/ Submurgence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	
	Surface Nuclear Confin. HVAC/Surface Nuclear Confin. HVAC/Portions of the surface nuclear confin. HVAC System(including MCCs and Load centers).	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	2.5 (Appx. C)	No	Yes	No	ITS Cooling (Ref.1, Sect.4.3.8 & Assump.3.2.4 of study)	Atmos@ Site Location.	59%-10%	2.5 (Appx. C)	No	Yes	No	ITS Cooling (Ref.1,Sect.4.3.8 & Assump.3.2.4 of study)	Atmos@ Site Location.	59%-10%	4.18E+04(Ref.8 & Note 7)	No	Yes	No	
	Electrical Power System/ Emergency Power/Feeders including ITS Loads(including MCCs and Load centers).	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	ITS Cooling (Ref.1, Sect.4.3.8 & Assump.3.2.4 of study)	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	ITS Cooling (Ref.1,Sect.4.3.8 & Assump.3.2.4 of study)	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	
	Electrical Power System/ Emergency Power /Feeders in Duct Banks	2 F-116 F/ Continous(Note 4)	Atmos @ site location.	59%-10%	None	No	No	No	2 F-116 F/ Continous(Note 4)	Atmos@ Site Location.	59%-10%	None	No	No	No	2 F-116 F/ Continous(Note 4)	Atmos@ Site Location.	59%-10%	None	No	No	No	
	Electrical Power System/ Emergency Direct Current Power	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	ITS Cooling (Ref.1, Sect.4.3.8 & Assump.3.2.4 of study)	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	ITS Cooling (Ref.1,Sect.4.3.8 & Assump.3.2.4 of study)	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)				

FACILITY		NORMAL							OFF-NORMAL							EVENT SEQUENCES							
NAME	System/Equipment.	Temp F/dur.	Pressure	Relative. Humidity	Radiation(mrad/hr.)	Flooding/ Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/dur.	Pressure	Relative Humidity	Rad.(mrad/hr)	Flooding/ Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/dur.	Pressure	Relative Humidity	Radiation(mrad/hr)	Flooding/ Submurgence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	
	Electrical Power System / Emerg. Uninterruptible Power Supply Power	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	ITS Cooling (Ref.1, Sect.4.3.8 & Assump.3.2.4 of study)	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	ITS Cooling (Ref.1,Sect.4.3.8 & Assump.3.2.4 of study)	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	Yes	No	
	Electrical Support System/ Cable raceway /Portions of Cable Raceway supporting ITS Electrical Power for emerg. Power supply to Nuclear Conf. HVAC System	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	2.5 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	2.5 (Appx. C)	No	Yes	No	Note 12	Atmos@ Site Location.	59%-10%	4.18E+04 (Ref.10 & NOTE 7)	No	Yes	No	
	Fire Protection System /Fire Suppres./ Manual Isol. Valves leading to the Double-Interlock Preaction Sprinklers	90 F-65F/ Continous	Slightly below atmos @ site location.	59%-10%	1.5E+01 (Note 6)	No	N/A	No	Note 12	Atmos@ Site Location.	59%-10%	1.5E+01 (Note 6)	No	N/A	No	Note 12	Atmos@ Site Location.	59%-10%	1.50E+01	No	N/A	No	
7. Sub Surface Facility																							

FACILITY		NORMAL							OFF-NORMAL							EVENT SEQUENCES							
NAME	System/Equipment.	Temp F/dur.	Pressure	Relative. Humidity	Radiation(mrad/hr.)	Flooding/ Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/dur.	Pressure	Relative Humidity	Rad.(mrad/hr)	Flooding/ Submergence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	Temp/dur.	Pressure	Relative Humidity	Radiation(mrad/hr)	Flooding/ Submurgence(Y/N)	Water Spray(Y/N)	Chem. Spray(Y/N)	
	Emplacement and Retrieval System/Waste Package Transportation/ Transport and Emplacement Vehicle	44 F-122 F (Ref.1,)	Slightly below atmos @ site location.	3%-10%	1.0E+2 (Ref.1, Sect. 4.10.1.3)	No	No	No	44 F-122 F (Ref.1, and Note 13)	Atmos@ Site Location.	3%-10%	1.0E+2 (Ref.1, Sect. 4.10.1.3)	No	No	No	44 F-122 F (Ref.1, and Note 13)	Atmos@ Site Location.	3%-10%	1.0E+2 (Ref.1, Sect. 4.10.1.3)	No	No	No	
	Emplacement and Retrieval System/ Waste Package Retrieval/ Support Equipment	44 F-122 F (Ref.1)	Slightly below atmos @ site location.	3%-10%	1.0E+2 (Ref.1, Sect. 4.10.1.3)	No	No	No	44 F-122 F (Ref.1, and Note 13)	Atmos@ Site Location.	3%-10%	1.0E+2 (Ref.1, Sect. 4.10.1.3)	No	No	No	44 F-122 F (Ref.1, and Note 13)	Atmos@ Site Location.	3%-10%	1.0E+2 (Ref.1, Sect. 4.10.1.3)	No	No	No	

APPENDIX B
NOTES

1. Wireless communications are designed to meet conventional electromagnetic compatibility (EMC) standards to prevent interference with radio frequency communications within and external to the communication system (Project Design Criteria Document, Section 4.3.7.2 [DIRS 178308]). Wireless communications are designed to meet conventional electromagnetic compatibility standards to prevent interference with safety-related instrumentation and control systems in accordance with Regulatory Guide 1.180 [DIRS 171818].

2. Harsh environments are environments that are postulated to (1) experience significant increased radiation, or temperatures, or both because of event sequences, (2) experience significant increased radiation, or temperatures, or both, because of off-normal environments, or (3) experience radiation levels, or temperature levels, or both, that significantly exceed common commercial limits. (Ref. 9, Section 1.13)

3. Mild environments are environments that are postulated to (1) experience no significant increased radiation or temperatures because of event sequences, (2) experience no significant increased radiation or temperatures, because of off-normal environments, or (3) experience normal radiation levels of less than 10E+04 rad Total Integrated Dose (TID) and temperature limits within common commercial limits.

4. The ambient maximum temperature for the 13.8 kV cables in duct banks, located at 3 ft below ground, will not exceed the cable maximum normal continuous operation temperature rating of 194° F (95° C) [DIRS 178308]. The Electrical Transient Analysis Program (ETAP) will determine heat losses and cable characteristics in duct banks.

5. ITS facilities, with the exception of the Subsurface Facility, are provided with automatic fire suppression and automatic fire alarm and detection systems [DIRS 177636] Basis of Design).

6. The Total Integrated Dose for EQ SSCs in R3 areas, and maximally exposed to 15 mrad/hr for 50 years is 6.6E+03 rads (TID).

7. The TID for EQ SSCs values for event sequences exposed to a conservative value of 4.18E+04 rads/hr for 30 days is 4.18E+04 rads/hr × 24 hrs/day × 30 days = 3E+07 rads (TID). The additional normal and off-normal TIDs shown in Appendix C, do not significantly affect the total life TID.

8. The objective of the Equipment Qualification Program is to utilize as the first choice, proven commercial technology, including facilities and ITS equipment previously qualified and accepted by the NRC to satisfy the intended function of the ITS SSC for YMP.

9. Flooding of ITS SSCs is precluded by passive design such as drains, flood control channels, curbs, elevated processing areas, and walls. Where such passive features are relied upon to prevent the submergence of ITS SSCs, those passive features are ITS.

10. There are no chemical spray hazards inside the ITS Nuclear facilities affecting ITS SSCs.

11. In order to limit the spread and release of airborne radioactive contamination to workers and the public, the HVAC system for the ITS nuclear facilities, with the exception of the Emergency Diesel Generator Facility and the Subsurface, includes an ALARA (non-ITS) confinement system. This system maintains a negative pressure, with respect to the ambient atmospheric pressure, in confinement areas resulting in a flow of air throughout the facility, continuously directed from the outside atmosphere (in-leakage) through confinement zones of progressively greater contamination potential, until it is ultimately exhausted or re-circulated through one or more stages of high-efficiency particulate air (HEPA) filters.

12. Event sequence temperature analysis work for ITS SSC has not been concluded. Partial information currently available indicates temperatures in this area have potential to be outside the range of values for which this ITS SSC has precedent of qualification acceptance by the NRC.

13. Per Project Design Criteria Document, Section 4.2.13.5.7, Table 4.2-5, in-drift air temperatures are maintained below 122 ° F when emplacement equipment is operating. Therefore, an ITS SSC will not be exposed to a temperature higher than 122 ° F during normal, off-normal and event sequence conditions.

APPENDIX C
ESTIMATION OF RADIATION DOSES FOR NORMAL AND OFF-NORMAL CONDITIONS

Subject: Estimate of Normal Doses and Off-Normal Doses for E.Q. Purposes.
Dated: 4/30/2007

IHF

Through put – 40 Waste Packages per year (Through put study).

Cranes	100 mrem/hr (c)	2,000 hrs (1)	200 rem (TID)
Yokes	1000 mrem/hr (b)	2,000 hrs (1)	2,000 rem(TID)
CTM/Trolley	100 mrem/hr (a)	2,000 hrs (1)	200 rem (TID)
HVAC	2.5 mrem/hr (d)	438,000 hrs (2)	1,095 rem (TID)

RF

Through put – 300 Casks per year (Estimated – Through put study not finalized).

Cranes	100 mrem/hr (c)	15,000 hrs (1)	1,500 rem (TID)
Yokes	1000 mrem/hr (b)	15,000 hrs (1)	15,000 rem (TID)
CTM/Trolley	100 mrem/hr (a)	15,000 hrs (1)	1,500 rem (TID)
HVAC	2.5 mrem/hr (d)	438,000 hrs (2)	1,095 rem (TID)

CRCF

Through put – 214 Waste Packages per year (Through put study).

Cranes	100 mrem/hr (c)	10,700 hrs (1)	1,070 rem (TID)
Yokes	1000 mrem/hr (b)	10,700 hrs (1)	10,700 rem (TID)
CTM/Trolley	100 mrem/hr (a)	10,700 hrs (1)	1,070 rem (TID)
HVAC	2.5 mrem/hr (d)	438,000 hrs (2)	1,095 rem (TID)

WHF

Through put –40 TADs per year (Through put study).

Cranes	100 mrem/hr (c)	2,000 hrs (1)	200 rem (TID)
Yokes	1000 mrem/hr (b)	2,000 hrs (1)	2,000 rem (TID)
CTM/Trolley	100 mrem/hr (a)	2,000 hrs (1)	200 rem (TID)
HVAC	2.5 mrem/hr (d)	438,000 hrs (2)	1,095 rem (TID)

Notes:

1. Time is arrived at by multiplying – (throughput) X (1 hr) X (50 yrs).
2. Time is arrived at by multiplying – (24 hrs/day) X (365 days/yr) X (50 yrs).

Remarks:

a. Waste package transfer trolley and Canister Transfer Machine deigned to 100 mrem/hr per PDC.
b. TAD lid designed to 1000 mrem/hr as per Preliminary Transportation, Aging and Disposal canister system performance specifications.
c. Intermittent dose rates should be limited to 100 mrem/hr per PDC.
d. CRCF is designed to the PDC.

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