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Kevin T. Walsh
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Arkansas Nuclear One

2CAN060903

June 18, 2009

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

SUBJECT: License Amendment Request
Technical Specification Changes To Relocate Pressurizer Heater Requirements to TRM
Arkansas Nuclear One, Unit 2
Docket No. 50-368
License No. NPF-6

Dear Sir or Madam:

Pursuant to 10 CFR 50.90, Entergy Operations, Inc. (Entergy) hereby requests the following amendment for Arkansas Nuclear One, Unit 2 (ANO-2). The proposed change will relocate portions of Technical Specification (TS) 3.4.4, *Pressurizer*, to the Technical Requirements Manual (TRM). TS 3.4.4 specifies operability requirements for both the water volume in the Pressurizer and the electric heater capacity of the Pressurizer. The proposed change will relocate the heater requirements to the TRM.

The heater bank and capacity requirements for the Pressurizer are not credited in the accident analyses and, therefore, are proposed for relocation to the station TRM. This is consistent with the intent of 10 CFR 50.36 in that the heaters do not meet the requirements for inclusion in the TSs. Changes to the TRM are controlled in accordance with the requirements of 10 CFR 50.59. The associated TS Bases, controlled in accordance with the TS Bases Control Program of TS 6.5.14, will also be relocated to the TRM. The relocation of the TS Bases is part of the ANO TS change implementation process; therefore, a markup of the TS Bases is not provided in this submittal.

In addition to the above, the percent-level described in TS 3.4.4 is relocated to the TS Bases. This "equivalent" to the 910 ft^3 limit contained in the TS can change over time due to changes in instrument uncertainty calculations or due to instrument replacement. Because the accident analysis is based on the volume limit, relocating the "percent" indication to the TS Bases does not result in a change to license basis or the actual TS limit.

The proposed change has been evaluated in accordance with 10 CFR 50.91(a)(1) using criteria in 10 CFR 50.92(c) and it has been determined that the changes involve no significant hazards consideration. The bases for these determinations are included in the attached submittal.

The proposed change does not include any new commitments.

Although this request is neither exigent nor emergency, your prompt review is requested. Once approved, the amendment shall be implemented within 90 days.

If you have any questions or require additional information, please contact David Bice at 479-858-5338.

I declare under penalty of perjury that the foregoing is true and correct. Executed on June 18, 2009.

Sincerely,

Brad Berryman for Kevin Walsh

KTW/dbb

Attachments:
1. Analysis of Proposed Technical Specification Change
2. Proposed Technical Specification Changes (mark-up)

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Attachment 1

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Analysis of Proposed Technical Specification Change

1.0 DESCRIPTION

This letter is a request to amend Operating License NPF-6 for Arkansas Nuclear One, Unit 2 (ANO-2).

The proposed change will relocate portions of Technical Specification (TS) 3.4.4, *Pressurizer*, to the ANO-2 Technical Requirements Manual (TRM). This TS specifies operability requirements for both the water volume in the Pressurizer and the electric heater capacity of the Pressurizer. The proposed change will relocate the heater requirements to the TRM. Changes to the TRM are controlled in accordance with 10 CFR 50.59.

In addition to the above, the percent-level described in TS 3.4.4 is relocated to the TS Bases. Because the safety analysis is based on the volume limit, relocating the "percent" indication to the TS Bases does not result in a change to license basis or the actual TS limit.

2.0 PROPOSED CHANGE

The electric heater portion of ANO-2 TS 3.4.4, *Pressurizer*, is proposed for relocation to the ANO-2 TRM. During relocation, the current TS Actions may be modified. Such modification, if performed, will be in accordance with the requirements of 10 CFR 50.59. A markup of the affected TS page is included in Attachment 2 of this submittal.

In addition to the above, the percent-level described in TS 3.4.4 is relocated to the TS Bases. This "equivalent" to the 910 ft^3 limit contained in the TS can change over time due to changes in instrument uncertainty calculations or due to instrument replacement. Because the accident analysis is based on the volume limit, relocating the "percent" indication to the TS Bases does not result in a change to license basis or the actual TS limit.

3.0 BACKGROUND

TS 3.4.4 requires two proportional heater banks to be operable in Modes 1, 2, and 3 with a capacity of ≥ 150 Kilowatts (kW) each. These heater banks are powered from vital AC buses backed by a respective TS-required Emergency Diesel Generator (EDG). In addition to the two proportional heater banks, non-vital back-up heater banks are also installed to help accommodate significant transients during normal power operation.

The pressure in the Reactor Coolant System (RCS) is controlled by regulating the temperature of the coolant in the Pressurizer, where steam and water are held in thermal equilibrium. Steam is formed by the Pressurizer heaters or condensed by the Pressurizer spray to reduce variations caused by expansion and contraction of the reactor coolant due to system temperature changes.

The Pressurizer heaters are single unit, direct immersion heaters which protrude vertically into the Pressurizer through sleeves welded in the lower head. Approximately one-third of the heaters are connected to proportional controllers which adjust the heat input as required to compensate for steady state losses and to maintain the desired steam pressure in the Pressurizer. The remaining backup heaters are connected to on-off controllers. These heaters are normally de-energized, but will automatically energize on a low Pressurizer pressure signal or high level error signal. This latter feature is provided since load increases result in an in-surge of relatively cold coolant into the Pressurizer, thereby decreasing the bulk water temperature. The Chemical and Volume Control System (CVCS) acts to restore level, resulting in a transient pressure below normal operating pressure. To minimize the extent of this transient, the backup heaters are energized, contributing more heat to the water. A low-low Pressurizer level signal de-energizes all heaters to protect the heaters should they uncover.

The Pressurizer proportional heater feeders are furnished with power (watt) transducers providing an analog value of the circuit power to the Safety Parameter Display System (SPDS). The magnitude of the power indicates the operational status and integrity of the heater bank.

The 150 kW of Pressurizer heater capacity powered from an assured power source will ensure that RCS subcooling margin will be maintained ≥ 20 °F for a period of 45 hours following loss of off-site power. This time period includes a period of one-half hour at the beginning of the transient in which the heaters are unavailable.

This calculation is conservative in that the actual heat losses would decrease during the transient as RCS pressure and temperature decreases, thereby prolonging the time to reach 20 °F margin-to-saturation.

The TS limit on Pressurizer volume exists to ensure the system is not operated under water-solid conditions. Such operation would preclude appropriate pressure control and could challenge the RCS pressure boundary. The percent-level indication provided in the TS was intended only as an operator aid and is not used in the accident analysis. This operator aid can change over time due to instrument replacement or calculation adjustment of instrument uncertainty. Therefore, it is proposed that this operator aid be relocated to the TS Bases.

The Pressurizer is discussed throughout the ANO-2 Safety Analysis Report (SAR), including Sections 5.5.10 and 7.7.1.1.2 (Reference 1). Note that the Pressurizer heaters are not discussed in SAR Chapter 15, *Accident Analysis*, nor credited in the accident analysis, except to state their loss on low Pressurizer level in Table 15.1.18-2.

<u>Natural Circulation</u>

Accident analyses presented in the SAR do not take credit for Pressurizer heater operation; however, an implicit initial condition assumption of the safety analyses is that the RCS is operating at normal pressure.

Although the heaters are not specifically used in accident analysis, the desire to maintain subcooled margin over the long term during a loss of offsite power, as indicated in NUREG 0737, *Clarification of TMI Action Plan Requirements* (Reference 2), is the reason for their original inclusion in the TSs. The requirement for emergency power supplies is also based on NUREG 0737. The intent is to keep the reactor coolant in a subcooled condition with natural circulation cooling at hot, high pressure conditions for an undefined, but extended time period after a loss of offsite power. While loss of offsite power is a coincident occurrence assumed in the accident analyses, maintaining hot, high pressure conditions over an extended time period is not evaluated in the accident analyses.

Following the accident at Three Mile Island in 1979, NUREG 0737 was developed by the NRC to address a wide array of needed safety enhancements at commercial nuclear power plants. As mentioned above, the Pressurizer heaters were included in NUREG 0737 to support natural circulation (i.e., loss of forced flow) conditions following a loss of off-site power. Reactor coolant pumps are lost when off-site power is lost and the RCS begins to transition to natural circulation as the hot water from the reactor core rises through the RCS hot leg piping to the Steam Generators (SGs) where it is cooled as it passes through the SG tubes and descends back through the RCS cold leg piping to the bottom of the core where it again absorbs heat from the core as it rises through the fuel region. This natural convection flow continues as long as a minimum water level is maintained in the SGs and thermohydraulic communication is maintained throughout the RCS hot and cold leg piping.

Following the TMI accident, it was believed that a plant cooldown via natural circulation could result in a steam bubble being formed in the reactor vessel head region. This is because the head region is a low or stagnant flow area of the vessel and would not be readily cooled by natural circulation flow. A slow cooldown would permit time for ambient heat losses from the reactor vessel head to afford necessary head-area cooling to inhibit steam bubble formation. However, a more rapid cooldown may not permit sufficient time for adequate vessel head cooldown and subsequently, formation of a steam bubble in the head region may occur. If this postulated condition were to continue uninhibited, it was thought the bubble could increase in size until it entered the hot leg piping, creating an adverse impact on the thermohydraulic communication needed to maintain natural circulation flow. Therefore, Pressurizer heaters were adopted as a means of increasing the RCS pressure to either maintain adequate subcooled margin with respect to vessel head conditions during natural circulation cooldown or to collapse any steam bubble in the vessel head should one develop.

<u>Benefit of Proposed Change</u>

On several occasions since initial startup, ANO-2 has experienced conditions where a proportional heater bank was found to narrowly meet the 150 kW TS requirement or found to have a capacity slightly below the TS requirement. Such conditions could prevent unit startup if discovered during a plant outage or could result in an unnecessary plant shutdown if discovered in Mode 1, 2, or 3. In addition, since the TS requirement for the proportional heaters is based on natural circulation cooldown support and therefore, a loss of offsite power event, the heater bank must be declared inoperable anytime its respective emergency power supply is removed for maintenance (i.e., the respective EDG or necessary switchgear/breakers). These conditions place an undue hardship on the plant and plant personnel in requiring significant prompt action or plant shutdown for an inoperable component that is not credited in the safety analysis and is not the only means of ensuring safe plant cooldown using the natural circulation method. Therefore, Entergy requests these non-credited heater bank requirements be relocated from the TSs to the TRM.

Because heaters provide necessary pressure control during power operation and can be an effective tool in supporting natural circulation cooldown, Entergy will continue to maintain appropriate functionality of the heater banks. Any future changes to the TRM heater requirements will be controlled in accordance with 10 CFR 50.59.

4.0 TECHNICAL ANALYSIS

TS 3.4.4 requires two groups of Pressurizer heaters, each with a capacity ≥ 150 kW and capable of being powered from an emergency power supply. The minimum heater capacity required is sufficient to maintain the RCS near normal operating pressure when accounting for heat losses through the Pressurizer insulation. By maintaining the pressure near normal operating conditions, a substantial subcooling margin can be maintained in the RCS loops during a natural circulation cooldown. The amount of heater capacity needed to maintain pressure is dependent on the ambient heat losses (see background information in preceding section).

As discussed in the Background section above, the post-TMI concern was the formation of a steam bubble in the reactor vessel head region during natural circulation cooldown of the plant. However, experience gained since the 1979 TMI accident indicates that there are other means of controlling head bubble formation and growth.

Note that the following discussions assume a natural circulation cooldown is required without a loss of RCS inventory that would result in loss of thermohydraulic communication in the RCS. Natural circulation cooldown is not relevant to such scenarios since the injection of borated water via high and/or low pressure safety injection pumps will be required to maintain inventory and support the necessary cooldown of the reactor core.

The most significant bubble prevention method is to control the rate of natural circulation cooldown while monitoring reactor vessel head temperatures. Besides Pressurizer heaters, NUREG 0737 also required a means of monitoring reactor vessel head temperature and reactor vessel reactor coolant level. ANO-2 has multiple Core Exit Thermocouples (CETs) for use in monitoring temperature in the upper regions of the reactor vessel. At least 2 CETs are required per core quadrant in accordance with TS 3.3.3.6, *Post-Accident Instrumentation*, in Modes 1, 2, and 3. ANO-2 also has a Reactor Vessel Level Monitoring System (RVLMS) that will indicate when steam bubble formation begins and monitor bubble growth during natural circulation conditions. Two channels of RVLMS are required to be operable in accordance with TS 3.3.3.6. The Plant Monitoring System (PMS) and SPDS computer also provide real-time display of RCS pressure-temperature relationships to plant operators for monitoring subcooled margin, the rate of cooldown, and the driving force effectiveness (core delta-temperature), among other things. Operations procedures contain in-depth discussion and guidance with regard to head bubble formation, prevention, and mitigation during natural circulation cooldown conditions. In the years since the TMI accident, operators have continuously practiced plant cooldowns under natural circulation conditions using plant simulators. Based on current plant capabilities and extensive operator knowledge and experience, the uncontrolled formation and growth of a steam bubble in the reactor vessel head is extremely unlikely.

In addition to the above, RCS pressure can be increased by normal inventory makeup sources. RCS level slowly decreases as the RCS temperature is lowered during the cooldown. A charging pump or high pressure injection pump is used at ANO-2 to makeup for this “shrink” in RCS level due to density changes. However, level can be raised in the Pressurizer beyond that needed to account for the density changes which will result in an additional increase in RCS pressure. This method of pressure control is proceduralized and well understood by plant operators.

Notwithstanding the above, if a bubble were to form and grow to the point of reaching the top of the vessel flow region, the cooler temperature of the water in the flow region would immediately collapse the steam attempting to enter the hot leg. This is enhanced by the fact that natural circulation flow is relatively low and the transport time from the reactor vessel to the SG does not permit rapid entrainment of steam that could reach the top of the SG tubes and inhibit natural circulation flow. Therefore, even in the event the natural circulation cooldown is not as controlled as desired, the steam bubble should not be capable of preventing natural circulation flow. To project the improbable and assume that steam is transported from the upper region of the vessel to the top of the steam generator tubes and interrupt thermohydraulic communication, the coolant would then enter a state of reflux boiling where the hot water travels through the hot leg and up one side of the SG tubes, cools, and returns through the lower portion of the hot leg back into the reactor vessel. This is a well defined phenomenon that is discussed in Combustion Engineering (CE) topical CEN-114-P, Amendment 1-P (Reference 3). In summary, the overriding safety function of core cooling is maintained regardless of the methods used, or not used, to control a natural circulation cooldown.

If core cooling could be lost due to bubble formation in the reactor vessel head, procedures provide for re-establishment of core cooling by either collapsing the bubble or depressurize the RCS to permit high pressure safety injection. With regard to the former and as discussed above, Pressurizer heaters are not required for bubble collapse, but can be used to support bubble collapse if available.

During development of this proposed TS change, a natural circulation cooldown was performed on the simulator. The ANO-2 simulator remains updated with respect to physical changes to the plant, including heat production and heat losses. During the entire event, all Pressurizer heaters (both the proportional banks and backup banks) were maintained in OFF. An attempt was also made to place the plant in a condition of greatest challenge in that following a simulated reactor trip caused by a loss of offsite power, the plant was permitted to operate automatically until a head bubble was formed (saturated RCS conditions). Operator intervention following head bubble formation required a very slight cooldown over time using the upstream atmospheric steam dump valves and minimal feedwater supplied to the SGs. The cooldown was not required to be commenced until approximately 10 hours after event initiation. The cooldown was required to be adjusted slightly approximately once every 1.5 hours due to decay heat load decreasing over time. Twenty-four hours following event initiation, RCS temperature had only been reduced to 500 °F (normal cold-leg temperature is 545 °F) indicating that the plant can be maintained in Hot Standby (RCS temperature ≥ 300 °F) conditions for a significant period of time without excessive bubble formation and without the use of Pressurizer heaters. The simulated natural circulation cooldown was uneventful and presented no challenge to operators.

With regard to the simulated cooldown above, if a more rapid cooldown were desired, pressure reduction may be delayed due to the need to makeup to the Pressurizer water volume (volume shrinks as temperature decreases). In addition, normal post-trip Pressurizer level (41%) may be raised to approximately 80% level to assist in maintaining RCS pressure above saturated conditions. Nevertheless, the above simulated scenario provides evidence that permitting the RCS to enter a saturated state under controlled conditions does not present a challenge to operators nor does it present a challenge to safe reactor operation.

Although it is preferable to maintain the Pressurizer heaters to enhance operation during natural circulation cooldown, the associated limits and surveillance requirements do not meet the intent of 10 CFR 50.36 for inclusion in the TSs in that they are not installed instrumentation that is used to detect, and indicate in the control room, a significant abnormal degradation of the reactor coolant pressure boundary, they are not a process variable, design feature, or operating restriction that is an initial condition of a Design Basis Accident (DBA) or transient analysis that either assumes the failure of or presents a challenge to the integrity of a fission product barrier, and they are not a structure, system or component that is part of the primary success path and which functions or actuates to mitigate a DBA or transient that either assumes the failure of or presents a challenge to the integrity of a fission product barrier. In addition, the Pressurizer heaters are not a structure, system, or component which operating experience or probabilistic risk assessment has shown to be significant to public health and safety. As discussed above, the Pressurizer heaters are not required to prevent or mitigate any DBA, nor are they required to successfully complete a natural circulation cooldown through Mode 3. In Mode 4 (RCS temperature < 300 °F), Shutdown Cooling (SDC) may be placed in service as desired to exit natural circulation cooldown conditions.

The Pressurizer heaters are not critical to nuclear or public safety for any scenarios modeled in the ANO-2 safety analyses. Therefore, consistent with the intent of 10 CFR 50.36, the Pressurizer heater operability requirements, applicability, actions, and surveillance requirements may be relocated from the TSs to the TRM. Changes to the TRM will continue to be controlled under the provisions of 10 CFR 50.59.

In addition to the above, the percent-level described in TS 3.4.4 is relocated to the TS Bases. This "equivalent" to the 910 ft^3 limit contained in the TS can change over time due to changes in instrument uncertainty calculations or due to instrument replacement. Because the accident analysis is based on the volume limit, relocating the "percent" indication to the TS Bases does not result in a change to the license basis or the actual TS limit. The percent-level was originally intended as an operator aid. As such, this information is more appropriately controlled within the TS Bases. The TS Bases are controlled in accordance with TS 6.5.14, *Technical Specification (TS) Bases Control Program*.

5.0 REGULATORY ANALYSIS

5.1 Applicable Regulatory Requirements/Criteria

The proposed change has been evaluated to determine whether applicable regulations and requirements continue to be met.

There are no specific General Design Criteria (GDC) associated with Pressurizer heaters or the use of operator aids within the TSs (i.e., the current percent-level denoted in Technical Specification (TS) 3.4.4, *Pressurizer*). Pressurizer heaters are discussed in various documents, such as NUREG 0737. However, the proposed change does not eliminate maintaining Pressurizer heaters, but only acts to relocate the requirements from the TSs to the TRM. Additionally, the relocation of the percent-level denoted in the TS to the TS Bases does not change any TS limit or operating requirement. Based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will continue to be conducted in accordance with the site licensing basis, and (3) the approval of the proposed change will not be inimical to the common defense and security or to the health and safety of the public.

In conclusion, Entergy has determined that the proposed change does not require any exemptions or relief from regulatory requirements, other than the TS, and does not affect conformance with any GDC differently than described in the Safety Analysis Report (SAR).

5.2 No Significant Hazards Consideration

A change is proposed to the Arkansas Nuclear One, Unit 2 (ANO-2) Technical Specifications (TSs) to relocate portions of TS 3.4.4, *Pressurizer*, relating to the Pressurizer heater banks to the Technical Requirements Manual (TRM) and to relocate the percent-level information denoted in the TS to the TS Bases.

Entergy Operations, Inc. (Entergy) has evaluated whether or not a significant hazards consideration is involved with the proposed amendment by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of amendment," as discussed below:

1. Does the proposed change involve a significant increase in the probability or consequences of an accident previously evaluated?

   Response: No.

   The proposed change acts to relocate current Pressurizer heater requirements from the TSs to the TRM and percent-level information to the TS Bases. The heaters serve only a support role in maintaining normal operating pressure in the Reactor Coolant System (RCS) and in can be used to support maintenance of subcooled conditions during a natural circulation (loss of forced flow) cooldown of the plant. The heaters are not credited in any accident analysis for accident prevention or mitigation. The percent-level information is an operator aid and is not associated with any accident or safety analysis limit. Neither of these items are related to accident initiators.

   Therefore, the proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Does the proposed change create the possibility of a new or different kind of accident from any accident previously evaluated?

   Response: No.

   The proposed change does not result in any plant modifications or changes in the way the plant is operated. The proposed change only acts to relocate current Pressurizer heater requirements from the TSs to the TRM and to relocate the percent-level information denoted in the TS to the TS Bases. The proposed change is unrelated to any accident initiator.

   Therefore, the proposed change does not create the possibility of a new or different kind of accident from any previously evaluated.

3. Does the proposed change involve a significant reduction in a margin of safety?

   Response: No.

   The proposed change relocates current Pressurizer heater requirements from the TSs to the TRM and relocates the percent-level information denoted in the TS to the TS Bases. The heaters serve only a support role in maintaining normal operating pressure in the Reactor Coolant System (RCS) and can be used to support maintenance of subcooled conditions during a natural circulation (loss of forced flow) cooldown of the plant. The current TS-required capacity of each heater bank is well beyond that required to maintain RCS pressure during normal operations. Non-TS back-up heaters are also installed to support pressure control during anticipated transients. The heaters are not credited in any accident analysis for accident prevention or mitigation. Because the Pressurizer heaters will continue to be monitored and controlled, relocating the current TS requirements to the TRM will not present an adverse impact to plant operation. In addition, the Pressurizer heaters are not a structure, system, or component which operating experience or probabilistic risk assessment has shown to be significant to public health and safety. The percent-level information currently contained in the TS is an operator aid and is not associated with any accident or safety analysis limit.

   Therefore, the proposed change does not involve a significant reduction in a margin of safety.

Based on the above, Entergy concludes that the proposed amendment presents no significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of "no significant hazards consideration" is justified.

5.3 Environmental Considerations

The proposed amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluent that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

6.0 REFERENCES

1. ANO-2 SAR

2. NUREG 0737, November 1980

3. CEN-114-P, Amendment 1-P, "Review of Small Break Transients in CE's Nuclear Steam Supply System," July 1979

Attachment 2

2CAN060903

Proposed Technical Specification Changes (mark-up)

REACTOR COOLANT SYSTEM

PRESSURIZER

LIMITING CONDITION FOR OPERATION

3.4.4 The pressurizer shall be OPERABLE with a water volume of ≤ 910 cubic feet ~~(equivalent to ≤ 82% of wide range indicated level) and both pressurizer proportional heater groups shall be OPERABLE~~.

APPLICABILITY: MODES 1, 2 and 3.

ACTION:

~~(a)~~ With the pressurizer ~~inoperable due to~~ water volume ≥ 910 cubic feet, be in at least HOT SHUTDOWN with the reactor trip breakers open within 12 hours.

~~(b) With the pressurizer inoperable due to an inoperable emergency power supply to the pressurizer heaters, either restore the inoperable emergency power supply as required by TS 3.8.1.1 action b.3 or be in at least HOT SHUTDOWN within 12 hours.~~

SURVEILLANCE REQUIREMENTS

4.4.4.1 The pressurizer water volume shall be determined to be within its limits at least once per 12 hours.

~~4.4.4.2 The pressurizer proportional heater groups shall be determined to be OPERABLE.~~

~~(a) At least once per 12 hours by verifying emergency power is available to the heater groups, and~~

~~(b) At least once per 18 months by verifying that the summed power consumption of the two proportional heater groups is ≥ 150 KW.~~