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June 29, 1984

Director of Nuclear Reactor Regulation
Attention: Mr. B. J. Youngblood
Licensing Branch No. 1
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

SUBJECT: COMANCHE PEAK STEAM ELECTRIC STATION
DOCKET NOS. 50-445 AND 50-446
EQUIPMENT ENVIRONMENTAL QUALIFICATION
JUSTIFICATIONS FOR INTERIM OPERATION

REF: (1) 10 CFR Part 50.49
(2) TXX-3997 dated 6-28-83 and entitled "Environmental Qualificaton 10 CFR Part 50.49"

Dear Sir:

The environmental qualification rule (reference 1) requires that an analysis be submitted which shows that Comanche Peak Steam Electric Station (CPSES) can be safely operated until all the equipment qualification required by the new rule is completed. The applicability of this rule to CPSES is addressed in reference (2) and the required analysis is provided by this letter.

The equipment environmental qualification program at CPSES will be completed by fuel load except for the qualification packages noted in Attachment (1).

For each of these qualification packages, a justification for interim operation (JIO) is also attached. These JIO's provide the analysis required to show that CPSES can be safely operated until the equipment environmental qualification programs for these packages are completed.

Respectfully,

DRWoodlan for

H. C. Schmidt

DRW/grr
Attachments
Distribution: Original plus 40 copies

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ATTACHMENT (1) TO TXX-4209

Package Number*	Equipment
HE-7	Crosby Position Indication Device for Pressurizer Safety Valves
ESE-43 and 44	Incore Thermocouples, Connectors, and Reference Junction Box for Measurement of Core Exit Temperatures for Detection of Inadequate Core Cooling

*MS-7 (Turbine Driven Auxiliary Feedwater Pump Control Panel and Accessories), ESE-13 (Process Protection Sets), MS-611B (BOP Analog Control System), ESE-40 (DP Indicating Switches) and ESE-47 (Boron Dilution Event Detection and Mitigation) are qualification packages that are incomplete, but none are incomplete because of concerns relating to the environmental qualification of equipment in a potentially harsh environment. The programs are incomplete because of open items relating to the seismic qualification of equipment in a mild environment or because the mild environment sequence and report writing is still in progress. Where necessary, justifications for operation for these open packages will be submitted by a separate letter to address the seismic concerns, but the environmental qualification of this equipment is considered adequate based on the CPSES maintenance and surveillance programs as descibed in the CPSES FSAR.

ATTACHMENT (2) TO TXX-4209

JUSTIFICATION FOR INTERIM OPERATION

QUALIFICATION PACKAGE: HE7

EQUIPMENT: RCS Safety Valve Position 1-8010A, B & C

SUPPLIER/ MANUFACTURER: Westinghouse/Crosby

SPECIFICATION/ PURCHASE ORDER: P.O. CP-0001

SCHEDULED COMPLETION AND CERTIFICATION: February 28, 1985

FUNCTION/APPLICATION:

The position detectors provide positive detection of the position of the RCS Safety Valves.

EQUIPMENT FEATURES:

The position detector is a magnetically actuated reed type switch.

Background

The Crosby Position Indication Device (PID) provides two train safety grade position indication of the six inch Crosby Safety Valve. The design of the PID is such that the device does not load or in any way inhibit the motion of the Safety Valve stem, since any stem load will effect the operational characteristics of the safety valve. The PID is

TAG NUMBER	LOCATION	FUNCTION	NORMAL ENVIRONMENT T	P	RH	RAD	CH	ACCIDENT ENVIRONMENT T	P	RH	RAD	CH	OT
1-8010A	Containment Przr. Compt.	RCS Safety Position Indication	120	Atmo	70	$4x10^6$	None	268(1)	48.1	100	$1.9x10^3$	Yes	1 yr.
1-8010B	Containment Przr. Compt.	RCS Safety Position Indication	120	Atmo	70	$4x10^6$	None	268(1)	48.1	100	$1.9x10^8$	Yes	1 yr.
1-8010C	Containment Przr. Compt.	RCS Safety Position Indication	120	Atmo	70	$4x10^6$	None	268(1)	48.1	100	$1.9x10^8$	Yes	1 yr.

T is temperature in ^oF P is pressure in psig RH is relative humidity in %
RAD is radiation in RADS CH is chemical spray OT is operating time during and post accident

(1) Steam line break temperature reaches 334^oF for a short time.

located within the containment building and must demonstrate its safety grade function while being exposed to the environmental conditions within containment.

The Crosby design consists of a small permanent magnet that mounts on the stem of the safety valve. A hollow cylindrical structure, containing six reed switches around the inner perimeter, is then bolted to the top flange of the safety valve. (See Figure 1) The reed switches within this device are encapsulated in a metal tube which is then cast in epoxy in the annulus of this structure. These switches are positioned, relative to the magnet, to allow two switches to make continuity at three valve positions, fully closed, mid, and fully open. (The reed switches themselves are depicted in Figure 2)

Previous Environmental Qualification Testing

The Crosby PID has been subjected to the complete IEEE 382-1980 and IEEE 344-1975 qualification testing sequence. The PID successfully passed cyclic and thermal aging, containment pressure test simulation, normal/accident combined gamma radiation testing, plant induced vibration aging and seismic simulation. The specific parameters of these tests are as listed below:

Thermal Aging: 257^{o}F for 625 hours with 200 operational cycles.

Cyclic Aging: 800 cycles of operation.

Pressure Containment Test: 70 psig for 24 hours.

Radiation Test: 200 x 10^6 rads of gamma radiation (includes both normal and accident dosage).

Vibration Testing: Sweep rate and frequency: 5 to 200 to 5 hz two octaves per minute; Duration each axis: 90 minutes; Excitation: 0.75g.

Seismic Testing: Tested to IEEE-344-75 requirements for line mounted conditions with operability demonstrated during SSE tests.

During the performance of the first HELB/LOCA transient, however, the insulation resistance to ground of all the switch leads deteriorated to the point that switch continuity could not be determined. This transient consisted of a 10 second ramp from 120°F to 492°F, a holding time of 3 minutes at 492°F and then a rapid cooldown back to ambient. Superheated steam was the environmental medium and chamber pressures to 68 psig were accomplished. After this transient was completed, the test chamber was opened and the test unit was removed and inspected. The inspection revealed that steam had been adsorbed by the Viton grommets in the PID nozzles. These grommets were installed by Crosby as a manufacturing aid to hold the leads during epoxy casting and to preclude flow into the nozzle of unhardened epoxy. The lead wires had become completely saturated and thus no insulation capability remained on the wire jacket. Additionally, the Viton grommet was saturated with steam and caustic spray. This combination of effects resulted in an electrical path from the lead wire to the housing or ground. Electrically all the switches "appeared" closed resulting in an inability to determine valve position through the switches. The test unit was then placed in an environmental aging oven and a high altitude simulation chamber. The low pressure and heat in the chambers removed the moisture from the grommets and the insulation resistance returned to near normal values.

Before performing the second HELB transient, an attempt was made to protect the lead wires and Viton grommets from the steam and caustic spray. The leads into the device were trimmed to within one inch of the pipe nozzles on the side of the unit. Teflon insulated test wires were then spliced to the units leads. The pipe stubs were then potted with epoxy.

After the epoxy had cured, the test unit was returned to test. The second test transient was performed and the unit functioned as required. Six days later during the long term soak at saturated steam conditions and at a temperature of 259°F, the test unit experienced resistance to ground problems. While the switches could still be monitored electrically, the switches did not operate properly. Three switches were double actuating, two switches were fused closed and one switch was operating properly. After the test was completed, the test chamber was opened and the unit removed and inspected. It was noted that both the lead wire insulation and the splice were saturated with moisture and had become porous. The epoxy potting appeared to still maintain a seal between the threads of the pipe stub and itself.

Crosby returned the test unit to its plant for detailed evaluation and determined that steam and chemical spray had penetrated into the reed switch area by "wicking" down along the reed switch wires. This wicking caused the hermetic seal between the ferro magnetic reed switch leaves and the glass capsule to be broken. (See Reed Switch Figure 2) Failure of this seal results in loss of the Nitrogen gas within the capsule and a nonrigid leaf support. Loss of the nitrogen gas results in contact oxidation and excessive arcing. The nonrigid leaf support causes intermittent switch operation, ultimately resulting in no operation.

The wicking was initiated by the splice and the lead wires exterior to the epoxy potting which became saturated with the steam and chemical spray.

Crosby has initiated another complete IEEE test sequence on another PID in March 1984. This test unit will be installed in the test chamber with the lead wires encased in sealed conduit from the test unit pipe stubs to the exterior of the test chamber. This will preclude the direct impingement of steam and chemical spray onto the lead wires.

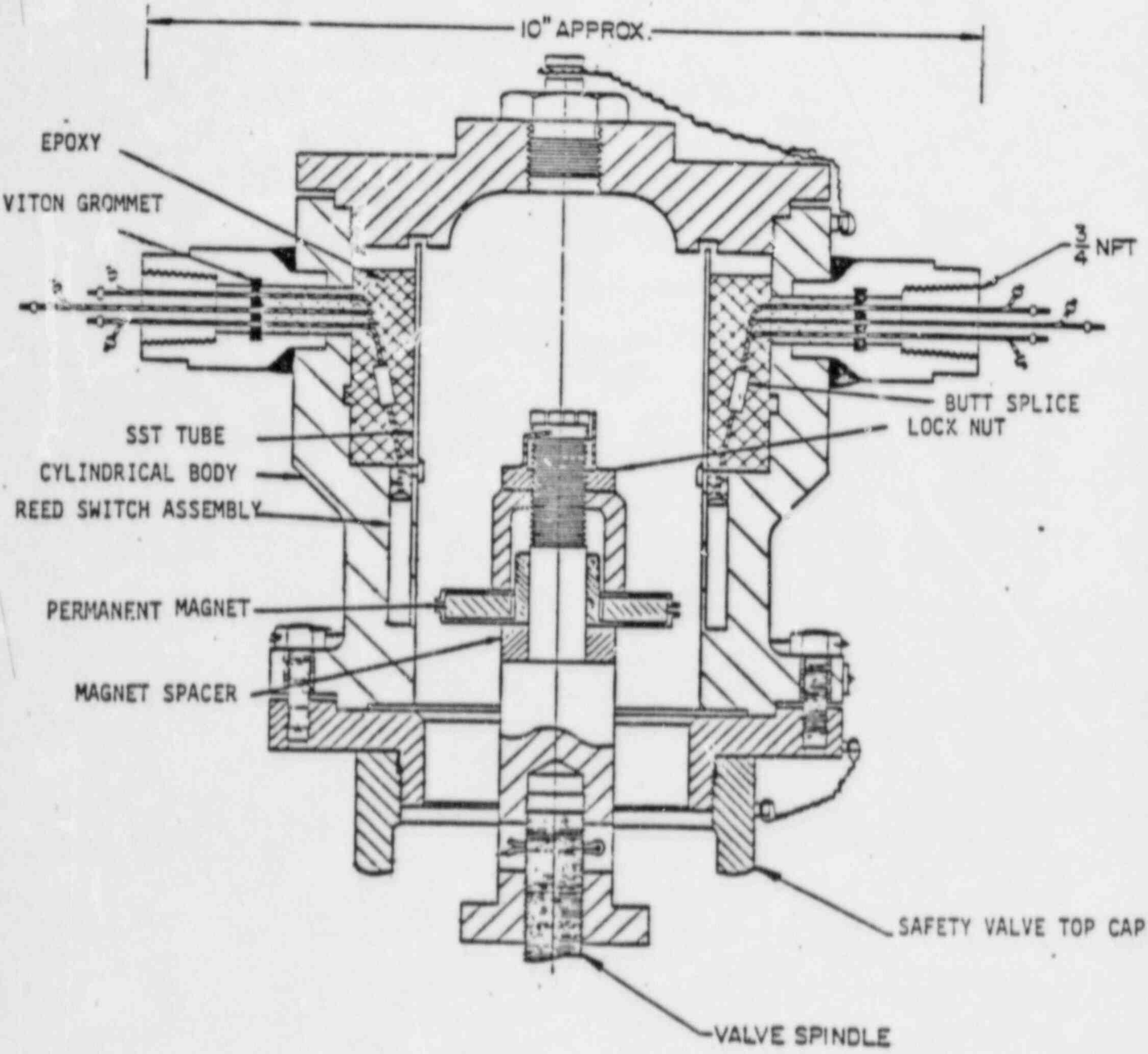
All interface requirements are illustrated on Westinghouse drawing DS-C-65628.

Conclusions

The failure mechanism of the Crosby PID was moisture/chemical spray inwicking along the lead wires that damaged the reed switches and degraded electrical performance of the switches. This failure mechanism will be eliminated by protecting the lead-in wires and Viton grommet from direct exposure to steam and chemical spray by sealing with conduit. The Crosby PID is being retested in this manner and is expected to successfully complete the testing.

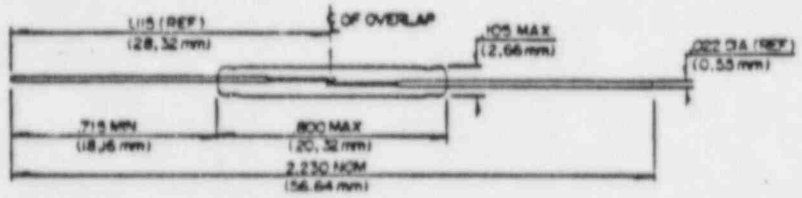
Sealed electrical assemblies are being added to the Crosby PID's at Comanche Peak. Based on the test results described above and the sealed installation at CPSES, there is no reason to suspect that the accident environment resulting from a design basis accident would cause a failure in these switches. There is no need to designate alternate equipment or to establish interim administrative controls.

CPSES can be safely operated until this qualification package is completed.



CROSBY POSITION INDICATION DEVICE

FIGURE 1



Hamlin 10 Watt Reed Switch (MARH-2) used in the
Crosby Position Indication Device

FIGURE 2

ATTACHMENT (3) TO TXX-4209
JUSTIFICATION FOR INTERIM OPERATION

QUALIFICATION PACKAGE: ESE43/44

EQUIPMENT: Incore Thermocouples, Connectors, Adaptors and Reference Junction Box
TBX-ICETC-01 and TBX-ELJIA

SUPPLIER/ MANUFACTURER: Westinghouse

SPECIFICATION/ PURCHASE ORDER: P.O. CP-0001

SCHEDULED COMPLETION AND CERTIFICATION: February 28, 1985

FUNCTION/APPLICATION:

This equipment provides temperature data for the core cooling monitoring system via the saturation margin monitor (see CPSES FSAR Section II.F.2.3). The data is used for operator information and the calculation of RCS saturation margin but is not used for any automatic actions.

EQUIPMENT FEATURES:

Fifty thermocouples are divided into two redundant trains (each train sensing all four quadrants of the core). The equipment is located as shown in the table below.

TAG NUMBER	LOCATION	FUNCTION	NORMAL ENVIRONMENT T	P	RH	RAD	CH	ACCIDENT ENVIRONMENT T	P	RH	RAD	CH	OT
TBX-ICETC-01	Containment RX Vessel	Thermocouple Junctions	750	-	-	-	-	~~2200~~	-	-	-	-	1 yr.
TBX-ICETC-01	Containment	Thermocouple Sheathed Cable	140	Atmo	70	$3.6x10^7$	None	268(1)	48.1	100	$8.4x10^7$	Yes	1 yr.
TBX-ICETC-01	Containment	Connectors	140	Atmo	70	$3.6x10^7$	None	268(1)	48.1	100	$8.4x10^7$	Yes	1 yr.
TBX-ELJIA	Containment	Reference Junction Box	120	Atmo	70	$4x10^5$	None	268(1)	48.1	100	$1.9x10^8$	Yes	1 yr.
TBX-ELJIA	Containment	Reference Junction Box	120	Atmo	70	$4x10^5$	None	268(1)	48.1	100	$1.9x10^8$	Yes	1 yr.

T is temperature in ^oF P is pressure in psig   RH is relative humidity in %

RAD is radiation in RADS   CH is chemical spray   OT is operating time during and post accident

(1) Steam line break temperature reaches 334^oF for a short time.

EQUIPMENT QUALIFICATION STATUS

The Class 1E thermocouples, connectors, and reference junction boxes located inside containment form part of a core exit temperature monitoring system and needs to be qualified for use during and after a design basis LOCA, SLB or seismic event. In addition to the HELB environment to which components inside containment might be subjected, the thermocouple junctions in the reactor vessel are to be qualified for operation in the event that a LOCA might lead to an inadequately cooled core (ICC). The generic DBE conditions to which Westinghouse is qualifying these components includes a 420^{o}F peak temperature HELB simulation with caustic spray and, for the thermocouple junctions, a 2200^{o}F peak temperature inadequately cooled core simulation.

The WRD qualification program is presently incomplete. Test sequence steps of accelerated thermal aging, normal radiation, and seismic simulation have been completed on the connectors but a retest is currently being scheduled. The reference junction box has been aged, irradiated and seismically tested but, due to a miscalculation, additional irradiation and LOCA testing will be required. The thermocouple test sequence has been completed. The status of completed testing and the basis for justification of interim operation with the system is provided below.

Thermocouples

The thermocouples, including the junctions and portions of stainless steel sheathed cable located inside the vessel have been subjected to seismic and LOCA conditions and demonstrated successful performance during and after the dynamic simulations. Accelerated thermal aging was not required because there are no organic materials in the thermocouple and the effects of high (normal) irradiation were considered in developing dynamic test inputs.

The thermocouples have also been subjected to a 2200^{o}F peak as an inadequate core cooling simulation and demonstrated successful performance both during and after the tests.

Connectors

The thermocouple connector assemblies have been subjected to accelerated thermal aging, irradiation (gamma and beta) and seismic simulation. The test program is being repeated because the radiation test dose was not adequate to simulate the required post accident dose.

The connector components are made of Ryton R-4, designed to tolerate high radiation exposure. Additionally, the metal outer sheath provides some shielding against exposure. Based on these facts, the additional radiation exposure is not anticipated to cause any changes in the previous successful test results.

A confidence test of the effects of a LOCA environment on a new LEMO connector has shown no effect on the accuracy of the thermocouple reading. These results are considered relevant to the question of performance of aged qualification units because the tendency for moisture to enter the unprotected connectors is the same for both new and aged samples. No evidence exists to suggest that the connectors will be more sensitive to HELB effects. Pending completion of the entire sequence of connector tests, the results of the HELB test of new connectors lend confidence of successful performance of the installed connectors.

Reference Junction Box

The Reference Junction Box (RJB) has been aged, irradiated and seismically tested successfully. However, a problem discovered prior to the LOCA test has altered the test program. During an external pressurization test it was discovered that the NEMA enclosure was not leak tight and would allow steam to enter the box during the LOCA test. Previous tests had revealed that RTD lead wires exposed to a steam environment would result in a substantial drop in the insulation resistance thus effecting the accuracy of the RTD. An attempt was made to seal the entire box with a silicone potting compound and perform a confidence test. If the potting method proved to be successful during the LOCA test a new box was to be modified with the potting and the test program repeated.

During the confidence test of the potted box the measured insulation resistance dropped substantially on all three RTD's indicating the potting had not sealed the box and that the RTD lead wires were being exposed to steam and caustic spray. However, a review of the data revealed little effect on the accuracy of the system (approximately 1%). WRD will continue the investigation of the apparent independence of insulation resistance and RTD performance. Present areas of investigation include the significance of data acquistion circuit variations and possible electro-chemical effects resulting from test measurement voltages in the presence of an electrolyte, such as the H_3BO_3/NaOH caustic spray. Similar results are described by N. J. Selley in an "Experimental Approach to Electrochemistry". In conjunction with the investigation, the validity of existing IR measurement techniques used in establishing performance is being evaluated.

The confidence test performed in the potted box demonstrated that the probability of obtaining a true environmental seal on the box by this method was low and was not required for successful system performance. After removal of the potting material from the qualification test unit, the HELB test was repeated and followed by a post accident simulation.

Upon completion of the test program it was realized that because of the inadequate seal it would not be possible to take credit for Beta-shielding. This lack of shielding increased the required TID for the post accident simulation. The test dose administered was adequate to simulate the 40 year normal operating dose prior to a seismic event. To address the increase in the required TID the reference junction box will be exposed to additional radiation and the HELB simulation repeated.

Because of components of the RJB were designed for a high radiation environment the additional exposure is not expected to affect its performance.

The results of sequential and confidence tests to date indicate that no changes are presently required in the installed thermocouple system and that adequate system performance is expected under all required conditions.

FAILURE ANALYSIS

The failure of this thermocouple system at CPSES is considered highly unlikely based on the extensive testing described above. However, loss of this system will deprive the operator of potentially useful information (core exit temperatures and saturation margin) but would not prevent any required automatic actions nor prevent adequate detection and mitigation of an accident. Indeed, this thermocouple system is part of the Inadequate Core Cooling backfit required by NUREG-0737 Supplement 1 (TMI Action Plan Item II.F.2) which is being backfit on all operating plants and NTOL's on plant specific schedules.

Because of the number of thermocouples installed, the independence and separation included in the design and the amount of other accident monitoring information available (see CPSES FSAR Section 7.5), either full or partial failure of the thermocouple system is not expected to mislead the operator in a manner that would cause him to take any unsafe actions.

CONCLUSION

The test results show that the thermocouples are fully qualified.

The test sequence for the connectors is incomplete, but partial test data and consideration of the radiation resistance of the design provides high confidence that the connectors will successfully complete the test sequence. More importantly, considering the significant amount of margin over the CPSES parameters, these connectors are fully expected to perform successfully in the CPSES containment for all postulated accidents.

The test sequence on the reference junction box is also incomplete, but the sequential and confidence tests run to date indicate that the system will perform properly using the presently installed reference junction box.

In summary, the substantial testing performed thus far clearly indicates that the installed thermocouple system will be successfully qualified and will perform properly at CPSES. There is no need to designate alternative equipment or to establish interim administrative controls.

CPSES can be safely operated until this qualification package is completed.