SMA 12901.03

APPENDIX A

INDIAN POINT UNIT 2
CONTROL BUILDING
SEISMIC IMPROVEMENT ANALYSIS

prepared for

PICKARD, LOWE AND GARRICK
Irvine, California

August, 1982

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by

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1. INTRODUCTION

During a recent probabilistic risk assessment of the Indian Point Unit 2 nuclear facility (Reference 1), one of the potential seismic failure modes identified as a possible contributor to risk involved impact between the roof of the Unit 2 control building and the Unit 1 superheater and turbine buildings. This failure mode considered impact levels of sufficient magnitude that dislocation and falling of ceiling-mounted items (such as light fixtures) could be expected with possible injury to operating personnel or damage to control cabinets and equipment. The median effective ground acceleration level associated with this mode of failure was established at approximately 0.27g. Although relatively low when compared with most of the other seismically-induced failure modes, this acceleration level is still nearly twice the Design Basis Earthquake (DBE) level of 0.15g.

A gap of 1.5 inches currently exists between the structures at the control building roof elevation, and 1 inch gaps exist at the two floor slabs. However, the flexibility of the upper story is considerably greater than the lower stories, so that impact at the floor slabs does not pose as severe a potential problem. The impact concern chiefly exists for north-south response between the control and superheater buildings. To some extent, a similar problem exists for east-west response between the control and turbine buildings. In this case, however, no gap exists between the turbine building steel frame and the unreinforced control building masonry wall. Failure of the masonry, either from its own inertia loads or loads transferred from the control building girts, is expected to result in essentially vertical, in-place collapse of the wall. This failure is expected to be localized in the extreme western end of the control building in the area of the turbine building stairwell and is not expected to impose an excessive hazard for operating personnel or equipment.

In order to increase the seismic capacity for the impact mode, several approaches are possible. One method consists of increasing the clearance from the current 1.5 inches around the control room roof to approximately 3.5 inches without the addition of any rubber pads. This would require no structural steel modifications and would retain the 1 inch expansion gaps at Elevation 53'-0" (control room floor) and below as currently exist. This modification was expected to increase the median ground acceleration capacity to approximately 0.45g (this value was calculated using the methods stated in Reference 1 and using an earlier, more flexible model of the superheater building). In order to achieve median ground acceleration capacities in excess of 0.45g by further increasing the clearance, the steel framing would require modification as would the 1 inch expansion gaps at the floor elevation. In order to develop the full seismic capacity of the control building without developing impact, nearly 8 inches clearance would be required at the roof elevation and approximately 3 inches at the control room floor elevation.

A second approach is to connect the control building to the superheater building so that impact between the structures will not occur. The engineering difficulty encountered with this approach is to design structure-to-structure attachment details capable of transmitting the loads within the limited space and access available. This approach would also require major structural modifications to connect the two structures and would require extensive additional analysis based on the resulting modified load distribution in order to verify the structural adequacy of the connected buildings.

The most promising approach, and the one recommended for implementation, consists of opening up the clearance between the structures at the control building roof elevation to the extent possible without requiring structural frame modifications (approximately 3.5 inches) and inserting rubber compression pads. The presence of the pads results in much lower forces being transmitted through the slabs than occurs through

the slab-steel impact. This occurs because the energy is transferred over a much greater distance (and time) and also because the pads tend to reduce the out-of-phase motion between the structures. No structural steel modifications are required for the building frames, and since some clearance is maintained between structures at all except very high seismic excitation levels, the normal functions of the construction gaps are not impaired.

This report presents the results of the analyses conducted to determine the design properties of the rubber pads and building modifications required. Recommendations for standard rubber pads are presented. Median effective ground acceleration capacities for the control building assuming implementation of the recommended pad design are included.

2. BUILDING ANALYTICAL MODELS

In order to evaluate the effects of the dynamic interaction between the control and superheater buildings, an overall mathematical model of the coupled control building structure and superheater building structure is required. At the ground acceleration input levels expected to result in roof failure with the rubber pads installed, a linear representation of the two building structures is considered adequate. However, the pad installation envisioned requires a nonlinear representation of the rubber pad effects.

2.1 PREVIOUS SUPERHEATER BUILDING MODELS

In 1969, John A. Blume and Associates analyzed the superheater building and steel stack to determine their ability to withstand the Operating Basis Earthquake (OBE) (Reference 2). The response spectrum chosen to represent the OBE was based on the average acceleration spectrum curves presented in Reference 3. The spectrum was normalized to 0.10g for both horizontal directions and to 0.05g for the vertical direction. The damping ratios chosen were 0.05 for reinforced concrete, 0.02 for bolted structural steel, and 0.01 for welded structural steel. The Blume model of the superheater building showing the calculated masses and stiffnesses in the north-south direction is given in Figure 2-1. The stack mass was included in the mass lumped at Elevation 135'-6". The Blume model accounted for the fact that the turbine building and the superheater building share a common column line by incorporating a portion of the former building's mass into the model. The building stiffnesses were based solely on the bracing system in the north-south direction. Table 2-1 lists the first 7 natural frequencies calculated for this model for the north-south direction.

The steel stack model is presented in Figure 2-2 along with masses and average section properties. The stack was analyzed as coupled to the superheater building using the north-south response of the super-

heater building. This direction showed maximum amplification of the ground motion and was used to determine the response of the stack. The first 7 natural frequencies calculated for this model are presented in Table 2-2.

In 1970, Westinghouse Electric Corporation performed a seismic analysis on the superheater building to determine the reinforcing necessary for the structural steel framing to make the building withstand the Design Basis Earthquake (DBE) (Reference 4). The DBE had a maximum horizontal peak ground acceleration of 0.15g. The analysis was limited to only horizontal motions in the north-south and east-west directions. A damping ratio of 0.07 was selected. This model was considerably more detailed than the original Blume model. In the Westinghouse analysis, all the major column lines were modeled. An example of a typical braced frame is presented in Figure 2-3. Reference 4 does not include an analysis or model description of the steel stack which was analyzed separately. The first 7 natural frequencies of the strengthened superheater building for the north-south direction are presented in Table 2-3.

The changes recommended by Westinghouse were to reinforce or replace existing bracing members. No additional bracing was introduced into unbraced bays. As a result, some of the column uplift forces became very large. In 1971, the firm Weiskopf and Pickworth was hired to reduce the column uplift forces to a more manageable level by adding bracing to unbraced bays. They also created a set of working drawings based on their recommendations. These drawings show the present building structure. A new analytical model of the structure was developed which included the latest added bracing as well as the effects of removing the superheaters from the building. This model initially assumed the superheaters and water in the condensate storage tanks were removed. The model was subsequently modified to include the mass of the water as well as the mass of anticipated offices to be added in place of the superheaters.

2.2 DESCRIPTIONS OF SMA CONTROL BUILDING AND SUPERHEATER BUILDING MODELS

The three-story, 57 foot-tall control building consists of seven moment-resisting bents in the north-south direction with both outside bents braced. A typical interior bent and the outside bent along Column Line "L-2" are shown in Figures 2-4(a) and 2-4(b). The top floor is significantly more flexible than the bottom two stories. The flooring is concrete slab with a nominal depth of 6.75 inches. The slabs were treated as flexible diaphragms because of their thickness and lack of shear connections to the supporting beams. The roof consists of metal decking, built-up roofing, and bullet-resistant steel panels. It was also considered to be flexible.

The superheater building is a multi-story, braced frame structure with five main bents in the north-south direction. Figure 2-3 in an upgraded condition is a typical bent. It is approximately 120 feet tall with a 265 foot steel stack on top. The stack originally was 80 feet taller, but was cut down to its present size to lessen the effects of potential tornado loads. (The original Blume analysis was performed with the stack at its original height). The building floors are partly concrete slab and partly steel grating. The roof is precast concrete slab. There is some horizontal bracing present at each floor. It is primarily concentrated along the south end of the building and around the two superheaters. The roof at Elevation 135'-6" has extensive horizontal bracing.

The steel stack is constructed of riveted steel plates with thicknesses varying from 11/16 inch at the base to 7/16 inch at Elevation 400'-0". The diameter of the stack at the base is 30'-0" and tapers to approximately 13'-8" at Elevation 400'-0". There is an inner lining of 2.5 inch-thick gunite. The stack also supports a ventilation duct carrying exhaust from the containment structure along with several steel grating platforms along its height. Only the varying thickness steel plates were used in computing the stack stiffneses, although the mass of the gunite was included.

The stiffnesses of the control building were determined by calculating the stiffness of each bent and adding them together for the two-dimensional model. Using this overall stiffness and the total mass for each elevation was equivalent to using an average stiffness and average mass per bent. The masses calculated for the control building were determined from the Westinghouse Electric Corporation drawings. These stiffnesses and masses are presented in Tables 2-4(a) and 2-4(b). The frequencies and mode shapes calculated for this model are shown in Figures 2-5(a), 2-5(b) and 2-5(c).

The superheater building model is shown in Figure 2-6 along with the masses associated with each elevation. This model was initially based on the assumption that the masses are the same ones used in the Blume analysis with the following exceptions:

i) Mass was deleted at Elevations 33'-0" and 135'-6" due to the anticipated removal of the two superheaters. The mass of the superheaters was estimated and assumed to be distributed in equal parts between the two elevations.

ii) Mass was deleted at Elevation 72'-0" due to the removal of water from the three condensate storage tanks at that level.

This model was subsequently modified to include the mass of the water as well as the mass of some anticipated offices. The stiffnesses calculated for both versions of the model were based solely on the bracing stiffnesses. The stiffness of bracing that would be in compression was included if the slenderness ratio (L/r) for that bracing was less than 120. The cut-off value of 120 was chosen because for A36 and A7 steel (the steel from which the bracing was made), this is approximately the point at which the allowable compression stress is equal to half the allowable tension stress. The stiffnesses used in this model are presented in Table 2-5.

The steel stack model is the same as the Blume model shown in Figure 2-2 with the following exceptions:

i) The stack was cut off at Elevation 401'-0".

ii) The mass at Elevation 401'-0" was reduced to reflect the reduced length.

The first 5 natural frequencies and mode shapes for the superheater building and steel stack are presented in Figures 2-7 through 2-11. For the current model, the fundamental frequency (0.96 Hz) is higher than either the Blume fundamental frequency (0.58 Hz) or the Westinghouse fundamental frequency (0.88 Hz). This is to be expected since this model is stiffer and has less mass than the original models.

TABLE 2-1

FIRST SEVEN NATURAL FREQUENCIES OF THE SUPERHEATER BUILDING ACCORDING TO THE BLUME MODEL FOR THE NORTH-SOUTH DIRECTION

MODE	FREQUENCY (Hz)
1	1.32
2	1.81
3	3.51
4	4.52
5	5.92
6	6.58
7	8.93

TABLE 2-2

FIRST SEVEN NATURAL FREQUENCIES OF THE STEEL STACK ACCORDING TO THE BLUME MODEL

MODE	FREQUENCY (Hz)
1	0.58
2	2.21
3	5.03
4	9.09
5	14.1
6	19.2
7	24.4

TABLE 2-3

FIRST SEVEN NATURAL FREQUENCIES OF THE SUPERHEATER BUILDING ACCORDING TO THE WESTINGHOUSE MODEL FOR THE NORTH-SOUTH DIRECTION

MODE	FREQUENCY (Hz)
1	0.88
2	2.13
3	4.12
4	5.65
5	6.99
6	8.26
7	9.09

TABLE 2-4(a)

STIFFNESS MATRIX USED TO DESCRIBE DEFLECTIONS AND DETERMINE FREQUENCIES AND MODE SHAPES OF CONTROL BUILDING (K/IN)

$$\begin{bmatrix} 2083 & -707 & 33 \\ -707 & 714 & -168 \\ 33 & -168 & 130 \end{bmatrix}$$

TABLE 2-4(b)

MASSES CALCULATED FOR CONTROL BUILDING (K-SEC^2/IN)

$M_1 = 1.43$	(Acts at Elevation 33'-0")
$M_2 = 1.19$	(Acts at Elevation 53'-0")
$M_3 = 0.492$	(Acts at Elevation 72'-0")

TABLE 2-5

STIFFNESSES CALCULATED FOR THE SUPERHEATER BUILDING

(BASED ON WEISKOPF AND PICKWORTH DRAWINGS)

FROM ELEVATION	TO ELEVATION	STIFFNESS (K/IN)
15'-0"	33'-0"	23,558
33'-0"	53'-0"	19,233
43'-0"	53'-0"	1,292
53'-0"	72'-0"	16,332
72'-0"	88'-6"	13,796
72'-0"	97'-7"	1,718
88'-6"	97'-0"	3,796
88'-6"	97'-7"	2,933
88'-6"	105'-6"	4,389
97'-0"	109'-10"	7,670
97'-7"	105'-6"	12,661
105'-6"	113'-11"	566
105'-6"	122'-6"	5,773
109'-10"	135'-6"	3,056
113'-11"	135'-6"	242
122'-6"	135'-6"	4,592

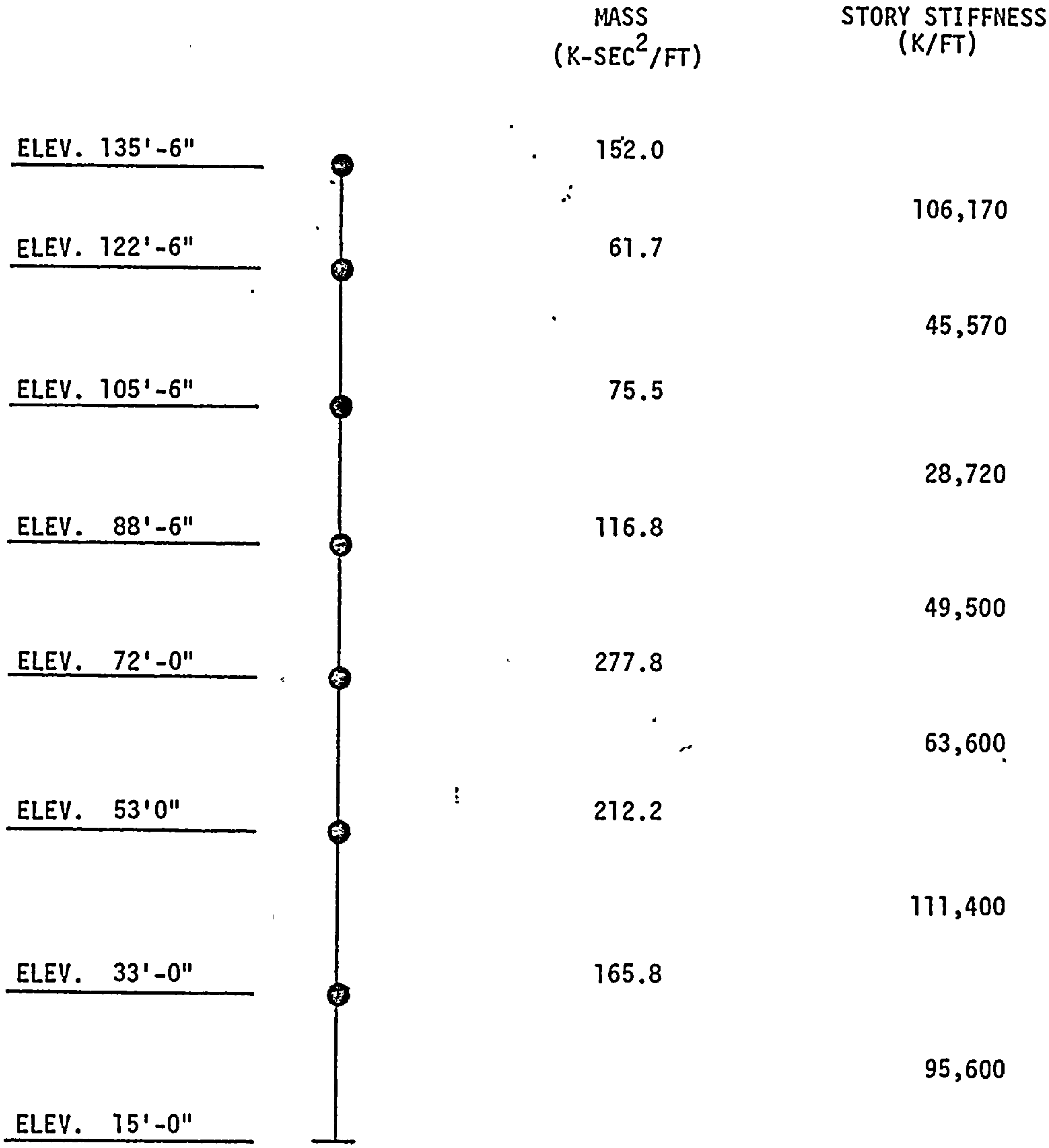


FIGURE 2-1. BLUME SUPERHEATER BUILDING MODEL SHOWING MASSES AND NORTH-SOUTH STORY STIFFNESS

Elevation	MASS (K-SEC²/FT)	I (FT⁴)	A_s (FT²)
ELEV. 470'-0"	1.300		
		14.50	0.575
ELEV. 447'-0"	1.180		
		21.60	0.655
ELEV. 424'-0"	1.330		
		30.61	0.740
ELEV. 401'-0"	2.160		
		41.89	0.820
ELEV. 378'-0"	1.863		
		55.65	0.900
ELEV. 355'-0"	1.960		
		72.14	0.980
ELEV. 332'-0"	1.959		
		91.59	1.065
ELEV. 309'-0"	2.226		
		114.27	1.145
ELEV. 286'-0"	2.422		
		160.28	1.400
ELEV. 263'-0"	2.642		
		194.35	1.495
ELEV. 240'-0"	2.894		
		262.28	1.785
ELEV. 217'-0"	3.134		
		311.13	1.890
ELEV. 194'-0"	3.396		
		405.96	2.215
ELEV. 171'-0"	3.766		
		473.23	2.330
ELEV. 148'-0"	3.121		
		584.79	2.675
ELEV. 134'-7.75"	2.093		

FIGURE 2-2. BLUME STEEL STACK MODEL SHOWING MASSES AND SECTION PROPERTIES

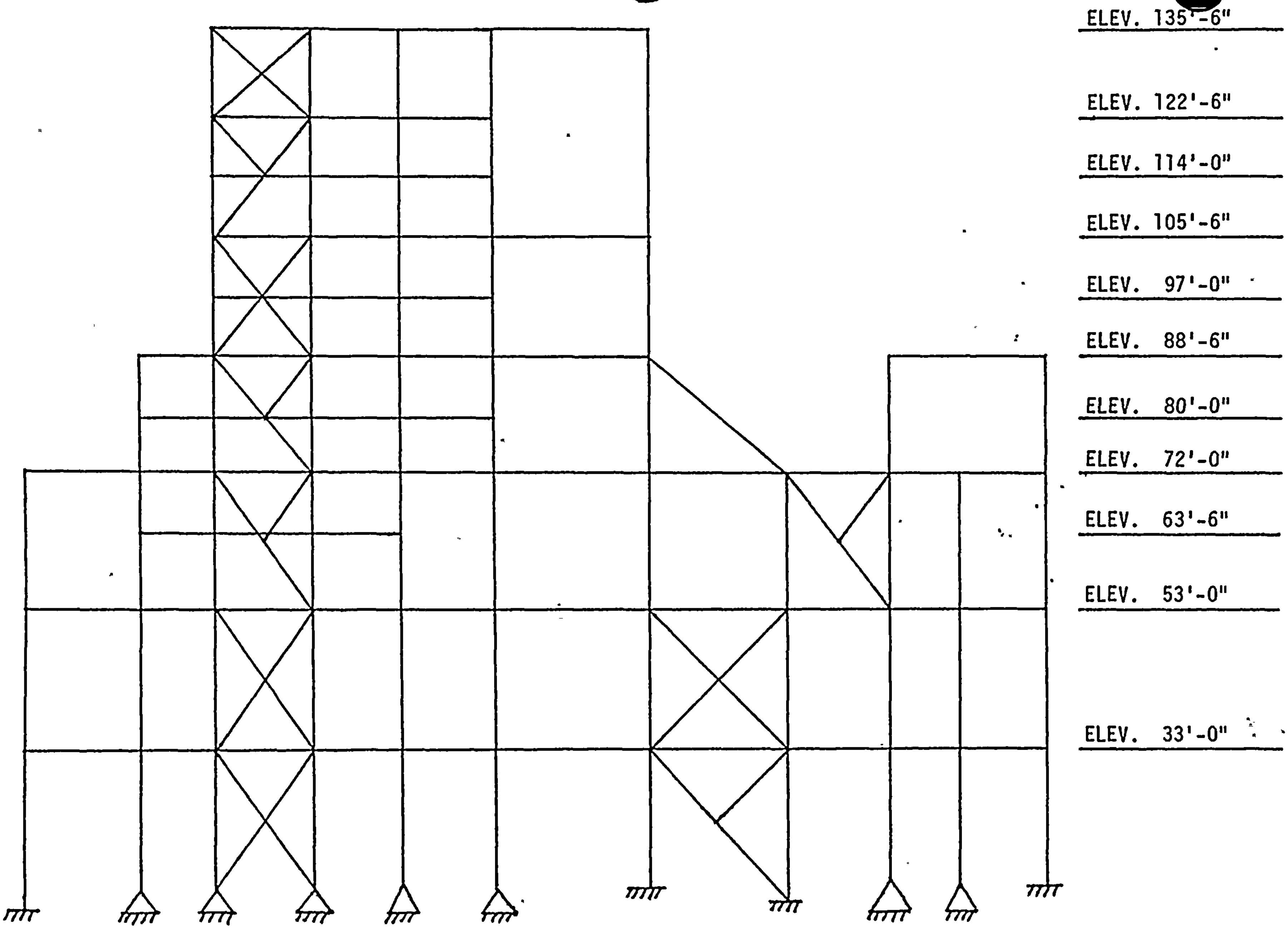
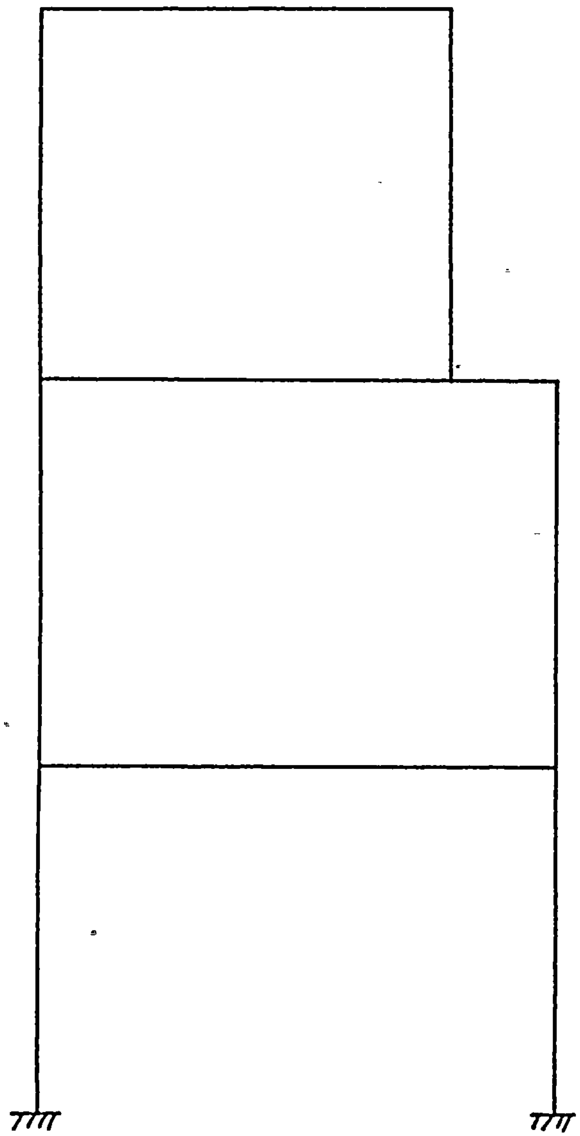
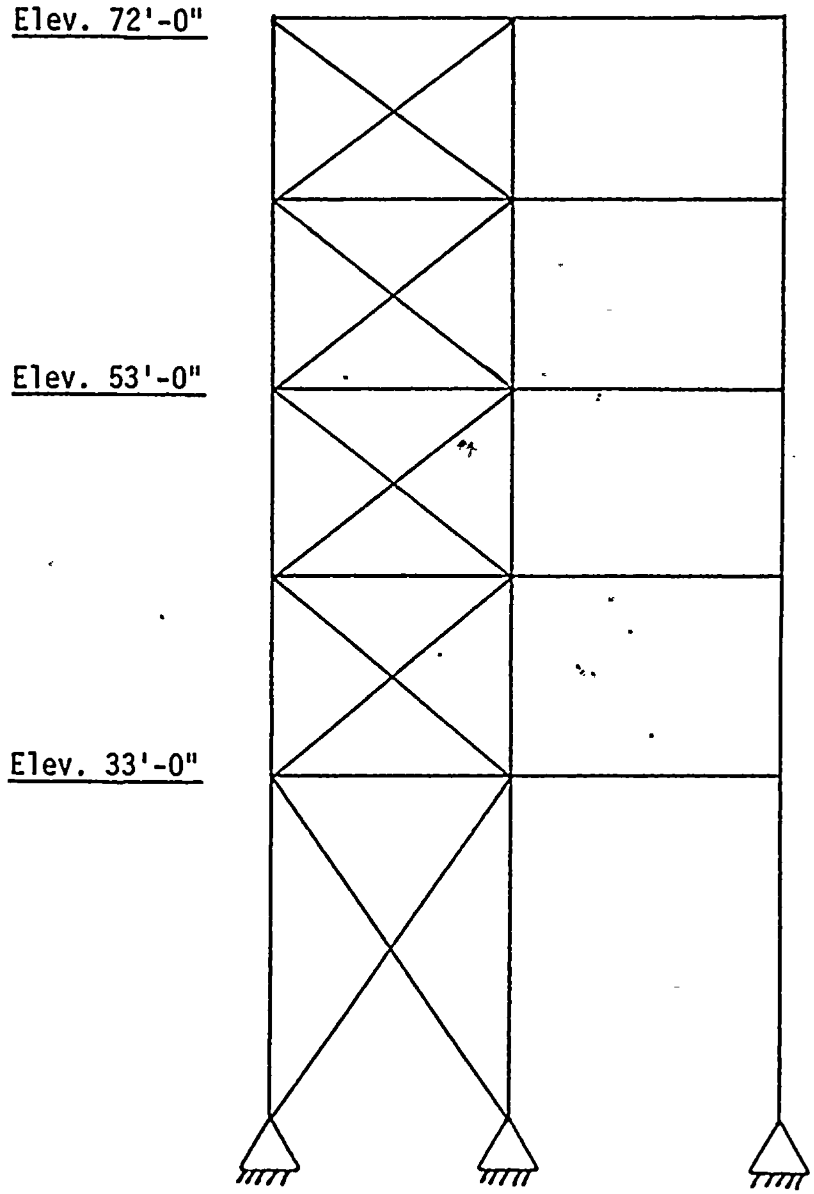


FIGURE 2-3. WESTINGHOUSE MODEL OF COLUMN LINE "L" IN SUPERHEATER BUILDING



(a)

FIGURE 2-4(a). TYPICAL CONTROL BUILDING INTERIOR BENT



(b)

FIGURE 2-4(b). CONTROL BUILDING COLUMN LINE "L-2"

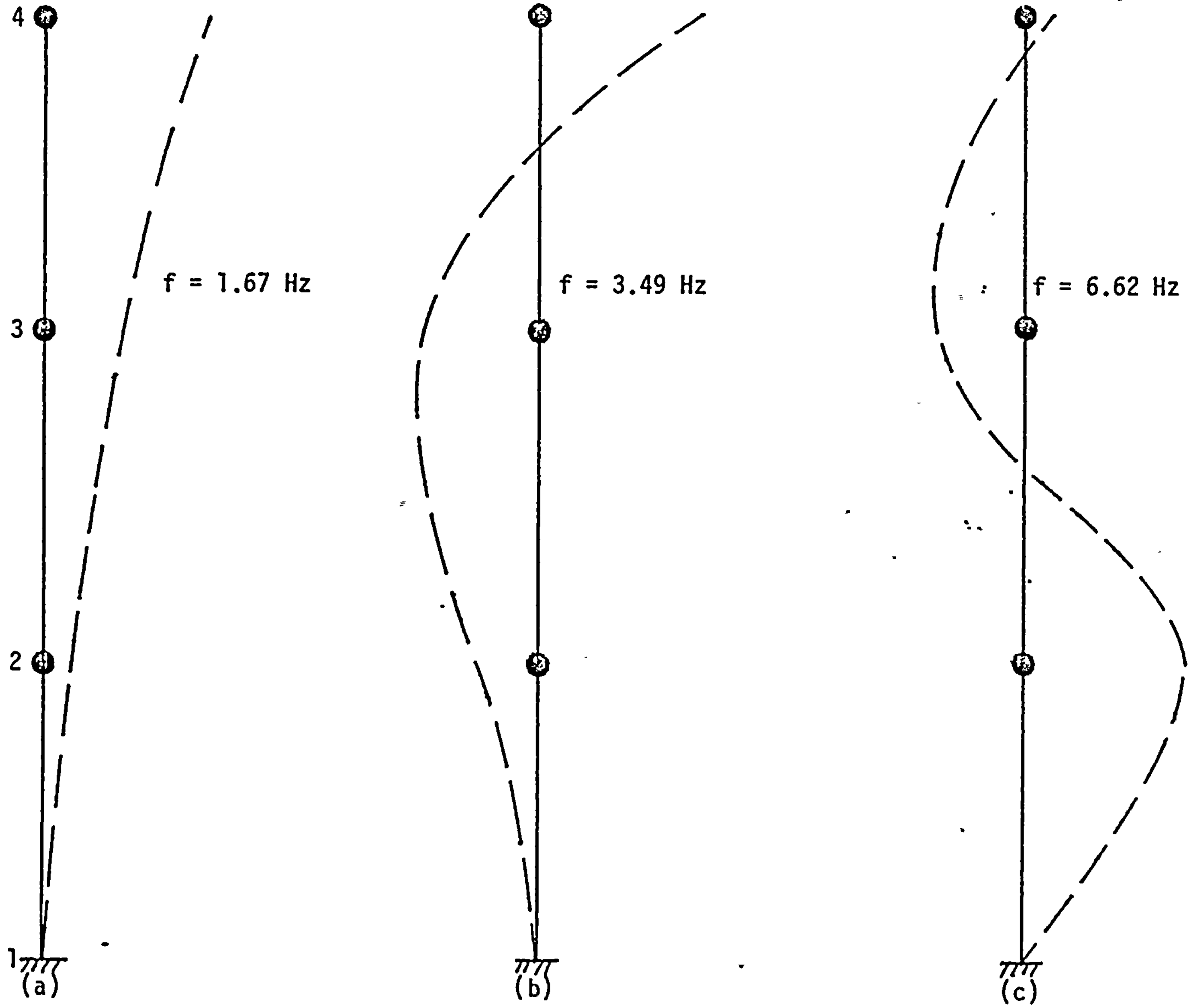


FIGURE 2-5(a) - (c). FREQUENCIES AND MODE SHAPES OF THE CONTROL BUILDING IN THE NORTH-SOUTH DIRECTION

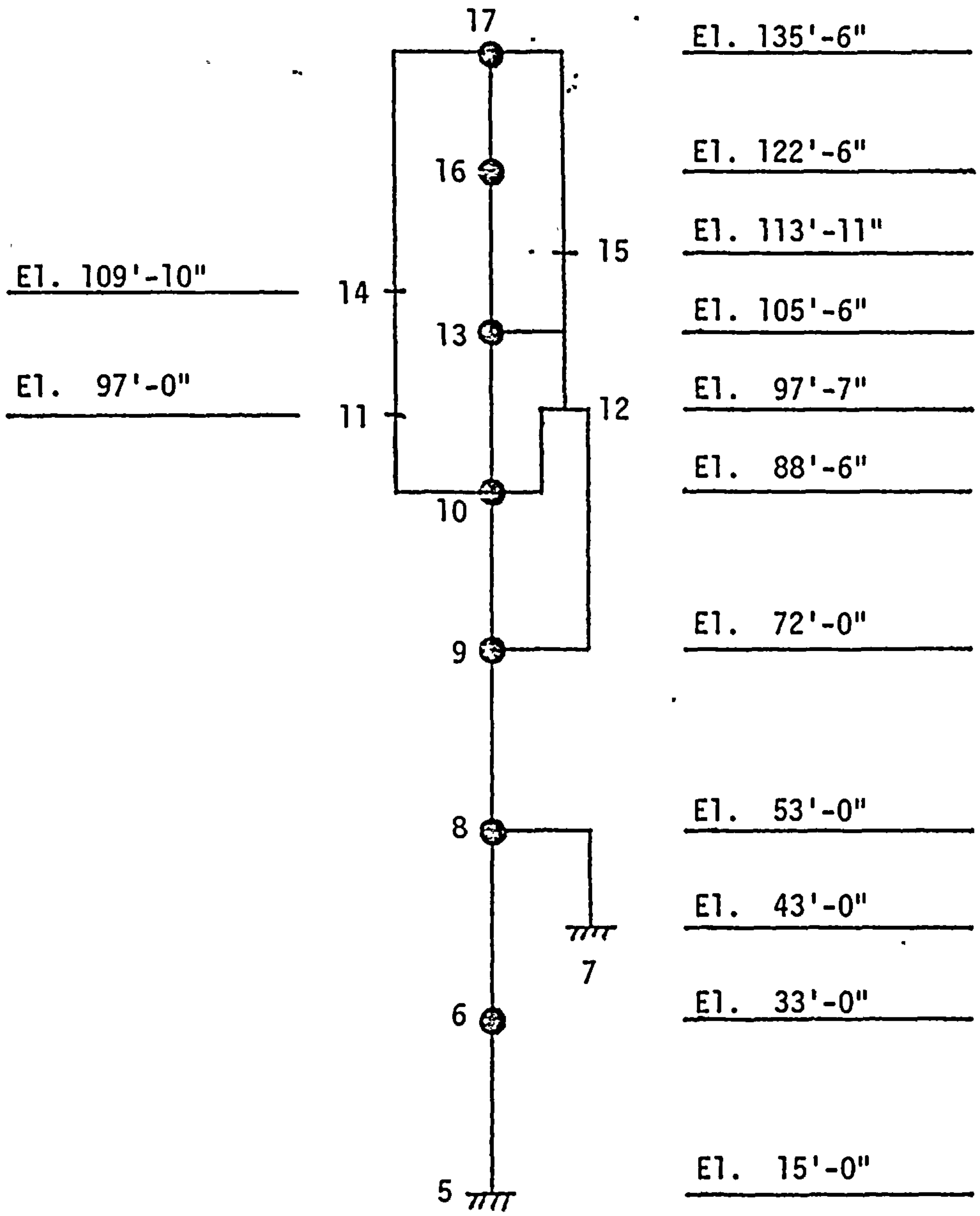


FIGURE 2-6. SUPERHEATER BUILDING MODEL

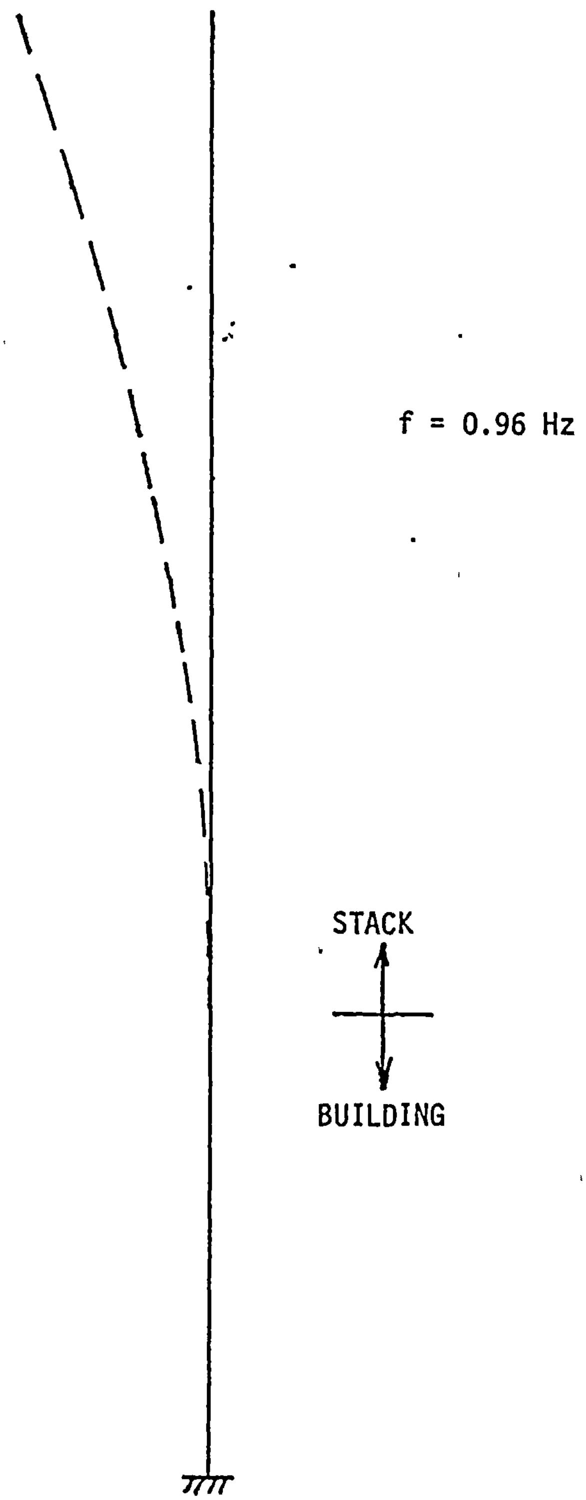


FIGURE 2-7. FIRST SUPERHEATER BUILDING MODE SHAPE IN NORTH-SOUTH DIRECTION

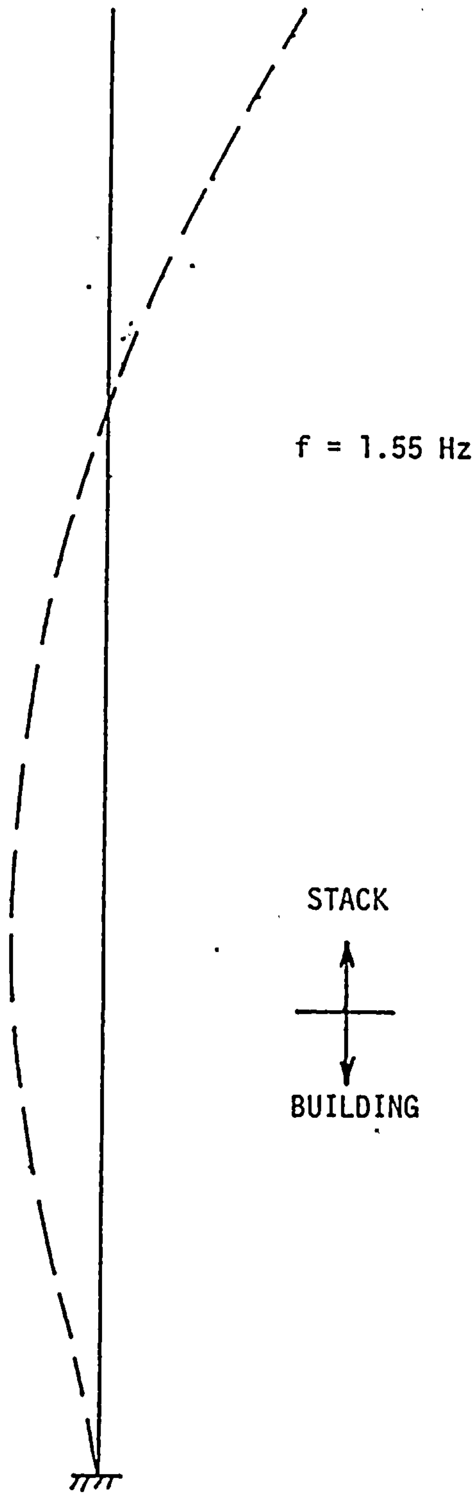


FIGURE 2-8. SECOND SUPERHEATER BUILDING MODE SHAPE IN NORTH-SOUTH DIRECTION

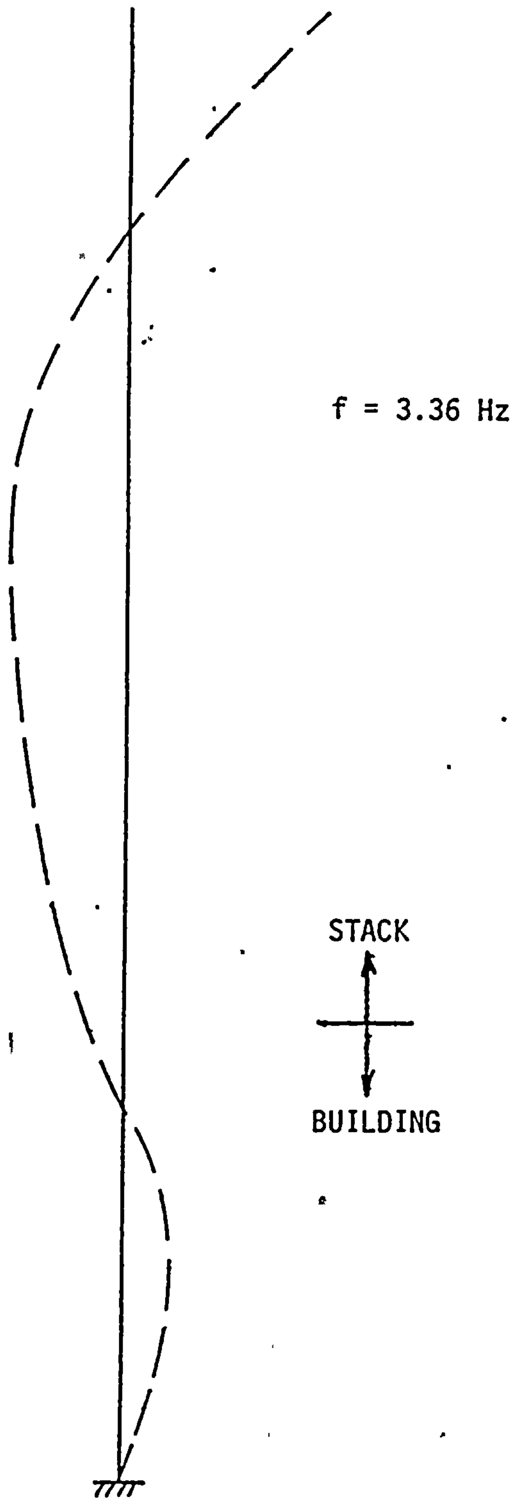


FIGURE 2-9. THIRD SUPERHEATER BUILDING MODE SHAPE IN NORTH-SOUTH DIRECTION

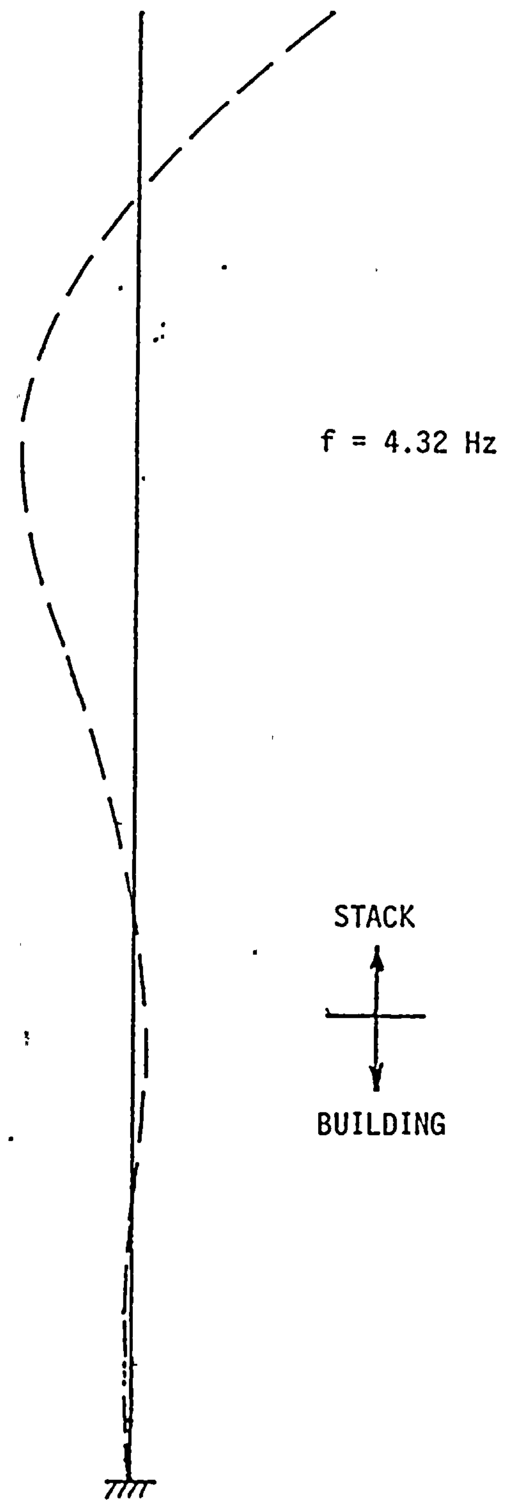


FIGURE 2-10. FOURTH SUPERHEATER BUILDING MODE SHAPE IN NORTH-SOUTH DIRECTION

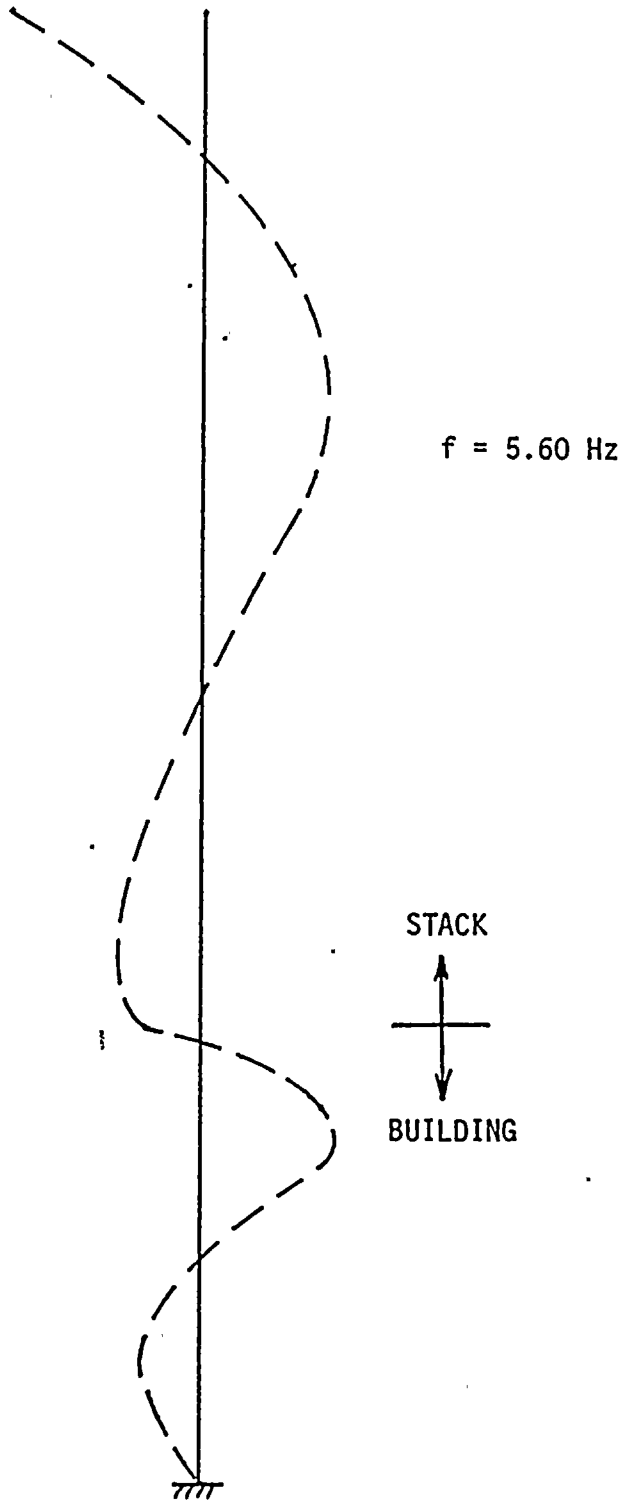


FIGURE 2-11. FIFTH SUPERHEATER BUILDING MODE SHAPE IN NORTH-SOUTH DIRECTION

3. ANALYTICAL VERIFICATION

In this section, the various time history analyses performed on the interaction between the control building and superheater building (including the steel stack) models are discussed. The first set of analyses involve coupling the two models together with a linear spring that takes both tension and compression. This initial parametric study was conducted in order to determine the appropriate range of rubber pad spring rates for evaluation and to ensure that commercially available pads were available with correct geometries and spring rates. The next set of analyses replaces the linear spring with one that acts only in compression. The structural damping value used for all analyses was 0.10. This is considered appropriate in view of the very high levels of excitation being considered. The analyses were performed on either MODSAP (Reference 5) or DRAIN-2D (Reference 6).

3.1 LINEAR ANALYSES

For these analyses, a spring of constant stiffness for both tension and compression representing the combined effects of the individual rubber pads was used to connect the control and superheater building models at Elevation 72'-0". This corresponds to node 4 of the control building model and node 9 of the superheater building model. The stiffness of this spring was varied in order to determine how the spring stiffness affected the maximum closure distance and force levels transmitted between the two buildings due to an earthquake. The earthquake record used for these initial analyses was an artificial one with a peak ground acceleration equal to 1.0g. Its response spectra essentially envelop those of Regulatory Guide 1.60 (Reference 7). The results of these analyses are shown graphically in Figure 3-1. From these results, it was decided that the combined connecting spring stiffness should be approximately 500 k/in. At this stiffness, a spring that is approximately 3.5 inches in length (the maximum clearance expected) has a maximum compressive strain of about 30 percent for a ground motion with a

peak acceleration of 1.0g. Since the artificial earthquake used represents the median plus one standard deviation spectra for both soil and rock sites, it was expected to produce higher response that would typically be anticipated for actual earthquakes. In order to evaluate this conservatism, two analyses were run using actual earthquake records scaled to a peak acceleration of 1.0g. The records chosen were the S69E component of the Taft earthquake of July 21, 1952, as recorded at Lincoln School and the N69W component of the San Fernando earthquake of February 9, 1971, as recorded on the Old Ridge Route at Castaic. The maximum closure distance at Elevation 72'-0" using these two records is 0.85 inch and 0.78 inch, respectively. This may be compared to 0.99 inch for the artificial record.

The first 8 natural frequencies for the two models connected by a 500 k/in linear spring are presented in Table 3-1. Also presented in this table are the first 5 natural frequencies for the superheater building by itself and the three natural frequencies for the control building by itself. Note, that the superheater building frequencies have not changed. This is due to the following reasons:

i) The superheater building is much stiffer and more massive than the control building.

ii) The connecting spring acts at the top of the control building, but relatively close to the base of the superheater building.

3.2 NONLINEAR ANALYSES

The linear analyses assumed that the connecting spring had a constant stiffness for both tension and compression. This, however, is not the case for rubber since rubber becomes stiffer as it is compressed. Furthermore, it is not necessary that the pads be attached to both structures, but only that they absorb the compression forces. In the as-built configuration of the two structures, the installation of the pads will be simplified if the pads are attached only to the control building.

For this method of attachment, no tension in the pads will occur. However, the system becomes nonlinear, and this must be reflected in the final analysis. Two types of nonlinear analyses were performed. For the first case, the connecting spring could take only compression and had a constant compression stiffness. For the final confirmatory case, the spring was again allowed to take only compression, but a varying compression stiffness was included.

The first set of nonlinear analyses were done to determine whether or not the 500 k/in stiffness chosen by the linear analyses was an appropriate choice. Two analyses were performed using the above-mentioned real earthquake records with the ground motion again scaled to 1.0g. For the Taft earthquake, the maximum spring compression was 0.76 inch while for the San Fernando earthquake, it was 0.74 inch. These results were slightly less but compare very well to the maximum compression as determined by the corresponding linear analyses of 0.85 inch and 0.78 inch, respectively.

For the final confirmatory set of nonlinear analyses, it was necessary to develop a force-deflection curve for rubber in compression. This was done in accordance with methods presented in Reference 8. The force-deflection curve used for these analyses is presented in Figure 3-2. Also shown is the force-deflection line for a 500 k/in linear spring. For the deformations expected at the ultimate load capacities as controlled by the roof decking puddle welds, the deviation of the nonlinear force-deflection relationship compared to the linear force-deflection relationship is not extremely significant. Note that for this curve, a deflection of 0.75 inch produces a force of 375 kips. This force would also be produced by a linear spring of 500 k/in at the same deflection. This coupled control building/superheater building model was subjected to the two real earthquake ground motions scaled to 1.0g. For the Taft earthquake, the spring had a maximum compression of 0.71 inch. This corresponds to a force of 350 kips. There was a maximum spring compression of 0.69 inch for the San Fernando earthquake. This compression corresponds to a force of 340 kips.

Analyses were also performed using the natural earthquakes with the ground motion scaled to 1.2g. These analyses gave a maximum compression of 0.89 inch for the Taft earthquake and 0.86 inch for the San Fernando earthquake. These compressions resulted in forces of 476 kips and 454 kips, respectively. Note that in increasing the peak earthquake acceleration from 1.0g to 1.2g, the maximum compression in the spring increased by about 25 percent while the maximum spring force increased by about 35 percent.

3.3 NONLINEAR ANALYSES USING SUPERHEATER BUILDING MODEL WITH INCREASED MASS

After these analyses had been performed, it was discovered that the condensate storage tanks would still be operational. There are also plans to convert the superheater building into offices. At lower elevations, the weight of the added office equipment is expected to be approximately equal to the weight of the equipment to be removed. However, at elevations above 88'-6", a net gain of approximately 2000 kips per floor is expected. Therefore, some additional analyses were performed in which mass equivalent to 2000 kips was added to the masses at Elevations 88'-6" and 105'-6" and the mass at Elevation 72'-0" was restored to the value used in the Blume analysis.

The first 5 natural frequencies and mode shapes for the increased mass superheater building model are presented in Figures 3-3 through 3-7. Comparing these natural frequencies to the ones listed in Figures 2-7 through 2-11, the greatest percentage change in frequencies occurs in the second and fifth modes where the natural frequencies are lower by 11 percent. In these modes, the elevations at which mass was added have more relative motion than in the other modes.

This model was again coupled to the control building model using a spring with the nonlinear force-deflection characteristic shown in Figure 3-2. It was expected that the maximum forces experienced by the spring would not change significantly and that, therefore, the preceding analyses were still valid in determining an appropriate spring rate. This system was then subjected to the Taft and San Fernando earthquake ground motions scaled first to 1.0g and then to 1.2g. For the Taft earthquake scaled to 1.0g, the spring had a maximum force of 408 kips with a maximum compression of 0.80 inch. For the same earthquake scaled to 1.2g, the maximum force was 597 kips with a maximum compression of 1.02 inches. The San Fernando earthquake scaled to 1.0g produced a maximum force of 315 kips corresponding to a deflection of 0.65 inch. Scaling this earthquake to 1.2g created a maximum spring force of 414 kips with a maximum compression of 0.81 inch. These results are presented in Table 3-2 along with previous calculated results for comparison. For the earthquakes that were scaled to 1.0g, the model with the added masses in the superheater building showed an average increase of 5 percent in the maximum spring force over the model without the added masses. For the earthquakes that were scaled to 1.2g, the average increase in the maximum spring force was 9 percent.

TABLE 3-1

COMPARISON OF NATURAL FREQUENCIES FOR THE TWO CONNECTED MODELS VS THE TWO UNCONNECTED MODELS

Mode	Connected Models Frequency (Hz)	Unconnected Models Frequency (Hz)
1	0.96 ①	0.96 ①
2	1.55 ①	1.55 ①
3	2.77 ②	1.67 ②
4	3.36 ①	3.36 ①
5	4.32 ①	3.49 ②
6	5.60 ①	4.32 ①
7	5.70 ②	5.60 ①
8	6.67 ②	6.62 ②

① Superheater building natural frequency

② Control building natural frequency

TABLE 3-2

COMPARISON OF MAXIMUM SPRING FORCES AND DEFLECTIONS FOR THE COUPLED SYSTEM USING THE DIFFERENT SUPERHEATER BUILDING MODELS

EARTHQUAKE	PGA	MAXIMUM SPRING FORCE (KIPS)		Percent Change	MAXIMUM SPRING DEFLECTION (IN.)		Percent Change
		Case 1	Case 2		Case 1	Case 2	
Taft	1.0g	350	408	+17	0.71	0.80	+13
Taft	1.2g	476	597	+25	0.89	1.02	+15
San Fernando	1.0g	340	315	-7	0.69	0.65	-6
San Fernando	1.2g	454	414	-9	0.86	0.81	-6

Case 1: Superheater Building Model Without Added Masses

Case 2: Superheater Building Model With Added Masses

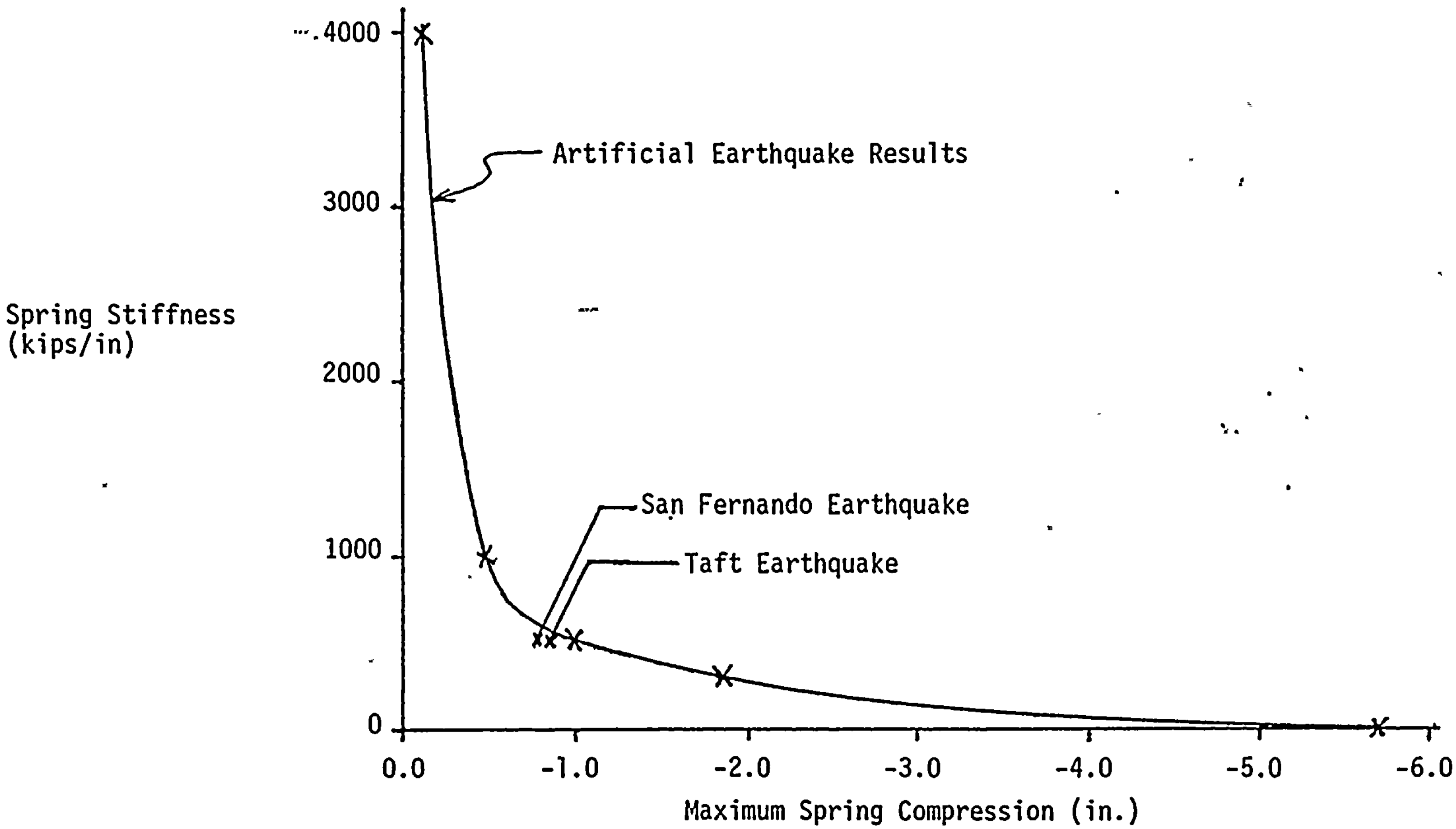


FIGURE 3-1. MAXIMUM COMPRESSION IN LINEAR SPRING CONNECTING CONTROL BUILDING AND SUPERHEATER BUILDING VS SPRING STIFFNESS

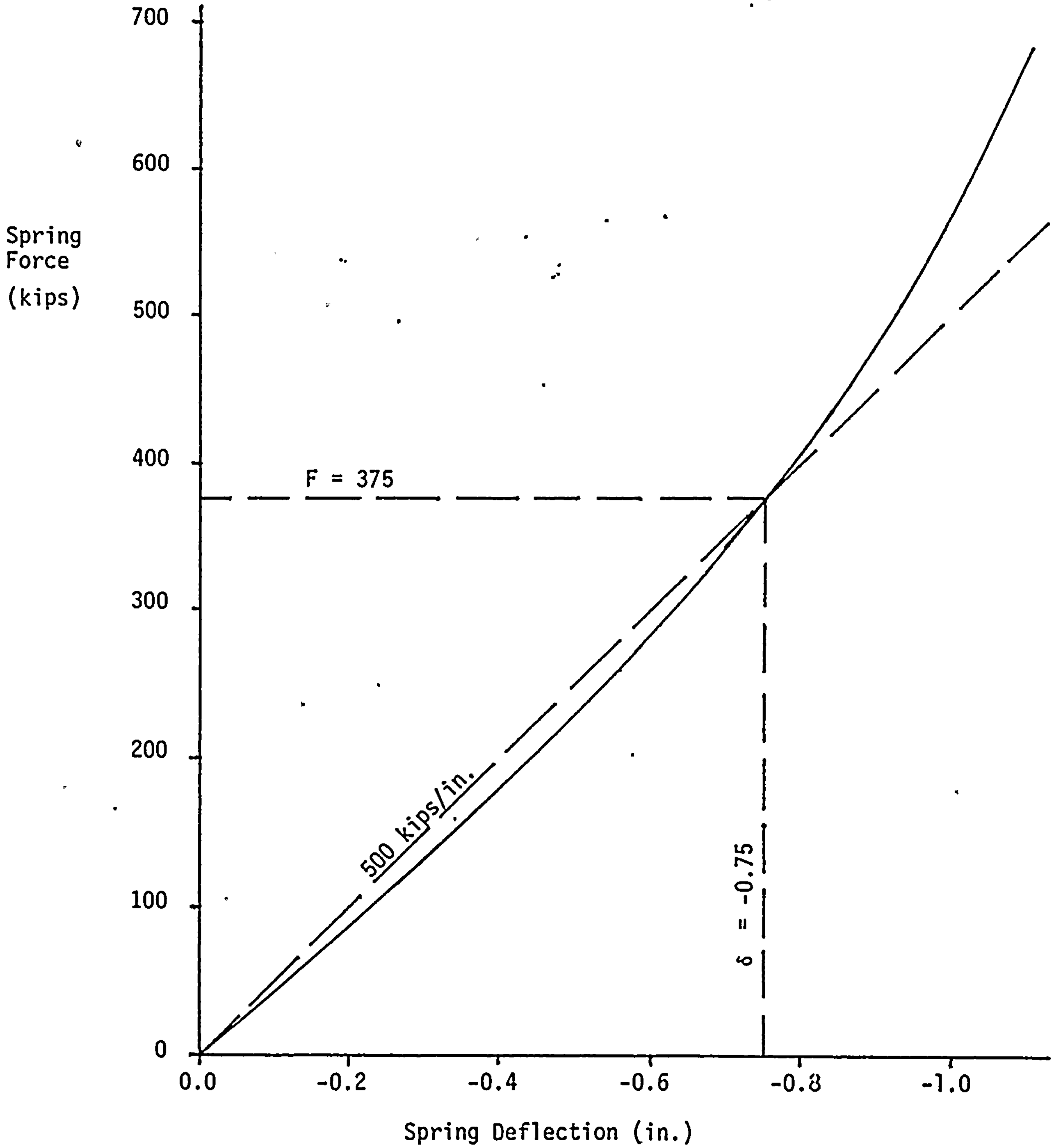


FIGURE 3-2. FORCE-DEFLECTION CURVE FOR RUBBER SPRING

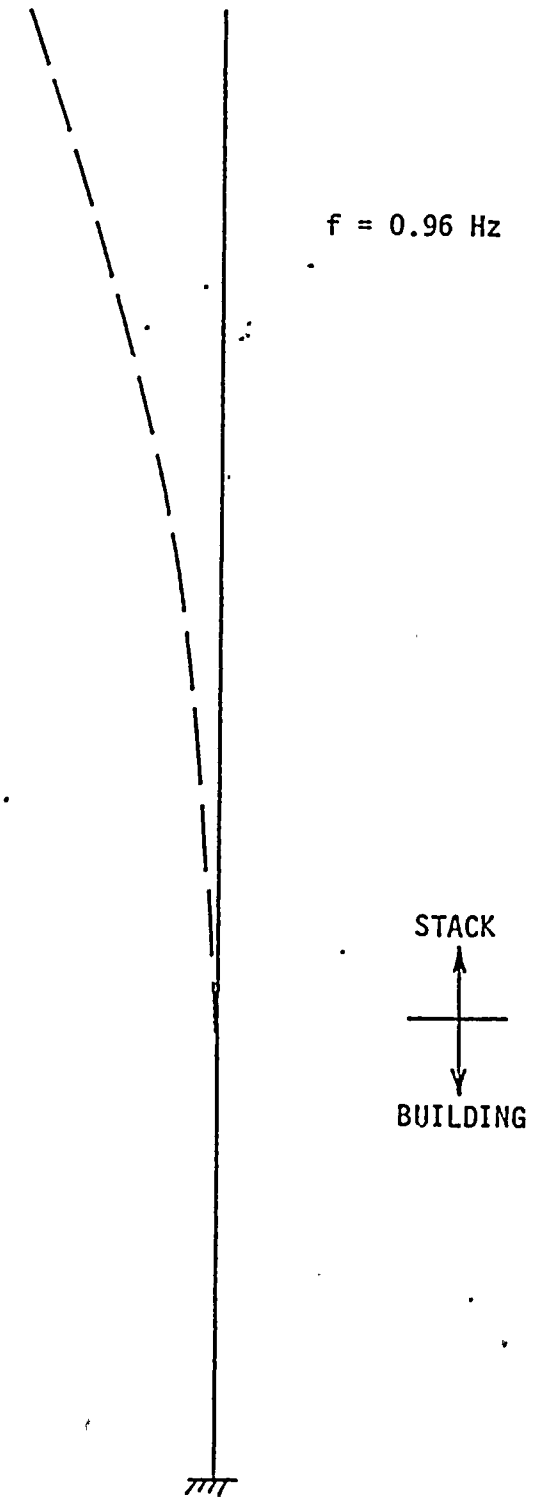


FIGURE 3-3. FIRST SUPERHEATER BUILDING WITH ADDED MASSES MODE SHAPE IN NORTH-SOUTH DIRECTION

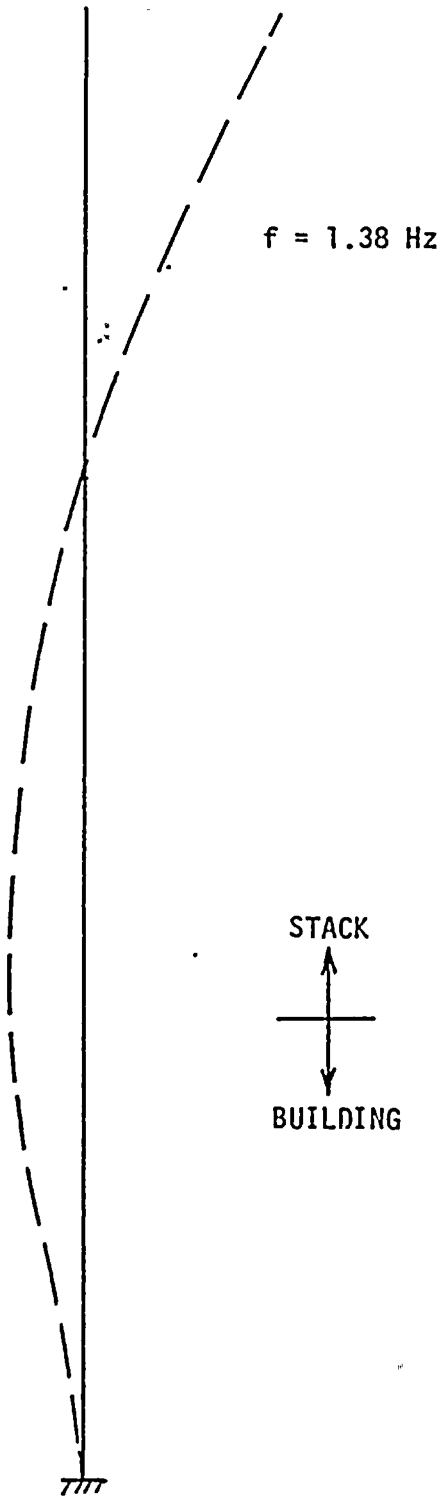


FIGURE 3-4. SECOND SUPERHEATER BUILDING WITH ADDED MASSES MODE SHAPE IN THE NORTH-SOUTH DIRECTION

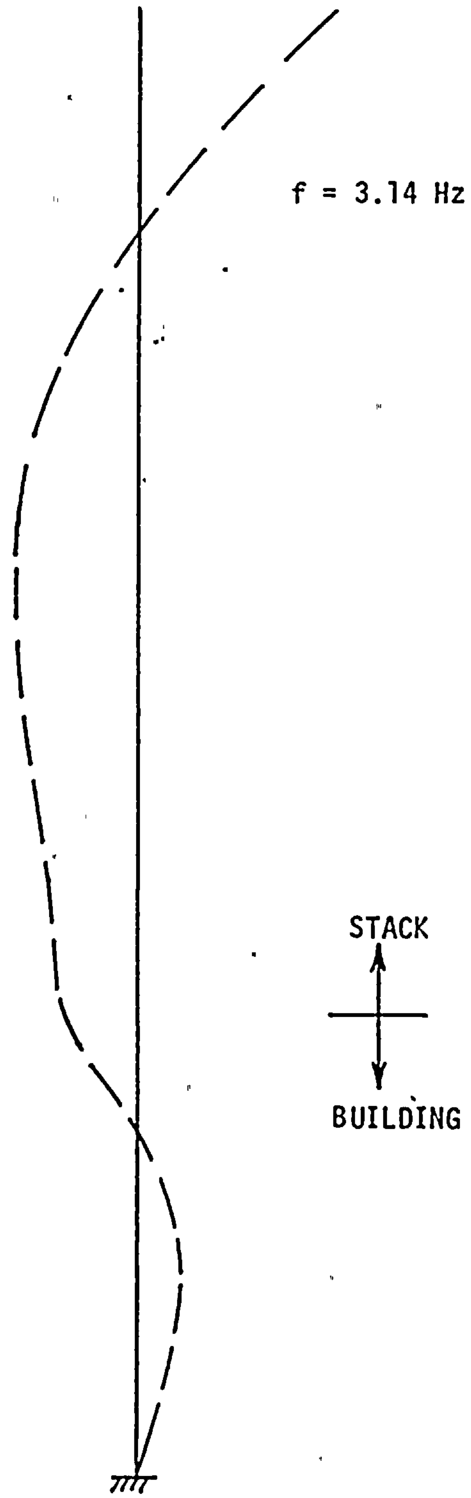


FIGURE 3-5. THIRD SUPERHEATER BUILDING WITH ADDED MASSES MODE SHAPE IN THE NORTH-SOUTH DIRECTION

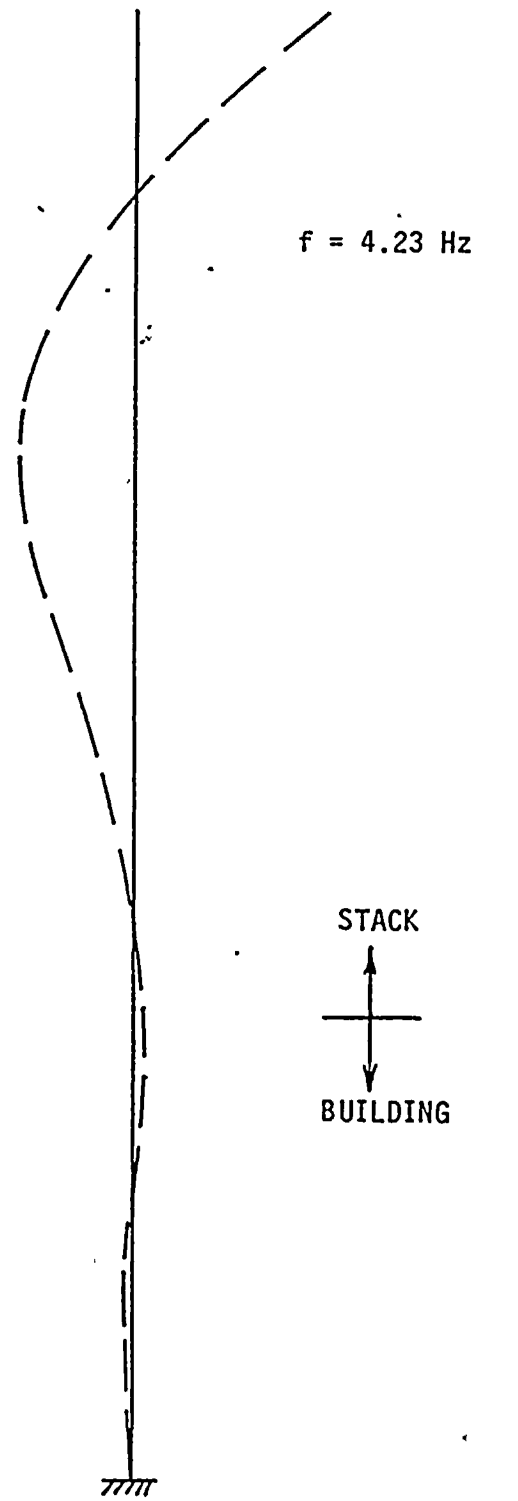


FIGURE 3-6. FOURTH SUPERHEATER BUILDING WITH ADDED MASSES MODE SHAPE IN NORTH-SOUTH DIRECTION

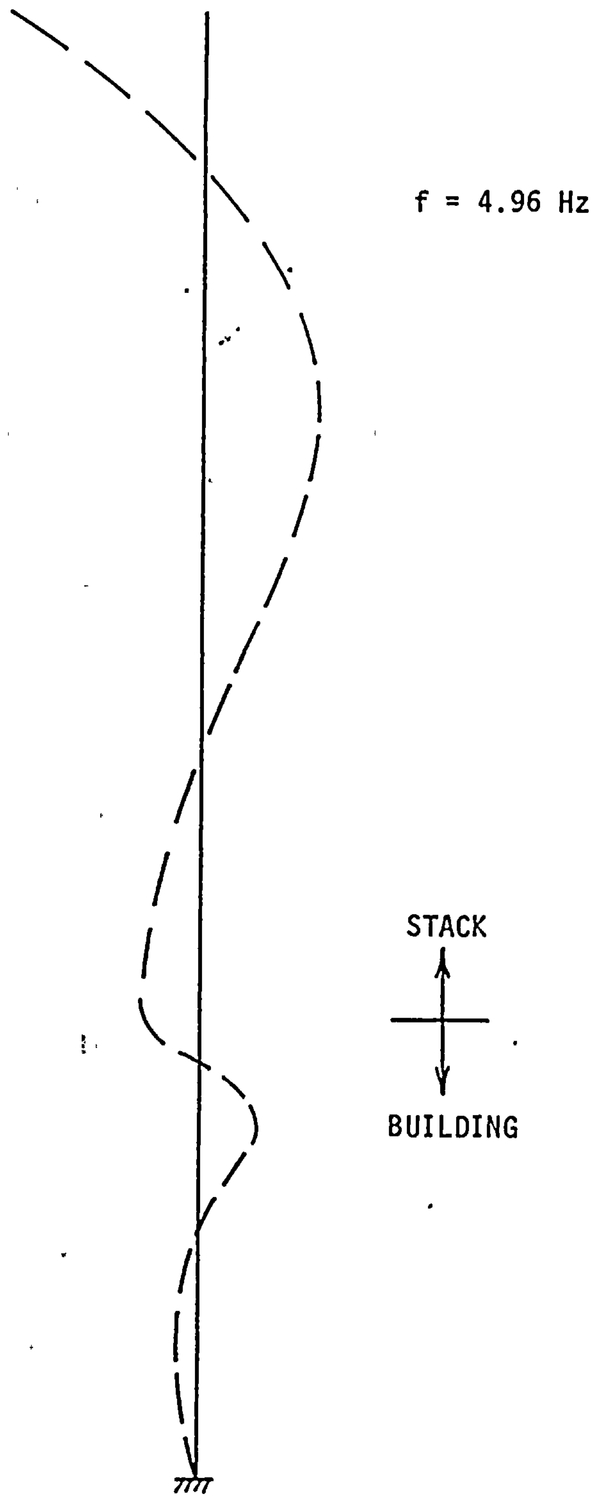


FIGURE 3-7. FIFTH SUPERHEATER BUILDING WITH ADDED MASSES MODE SHAPE IN NORTH-SOUTH DIRECTION

4. DESIGN CONSIDERATIONS

In this section, the recommended design configurations for adding the rubber pads will be presented. Also, seismic capacities of the control building roof impact mode of failure with the pads installed will be described and design specifications are presented.

4.1 RECOMMENDED PAD DESIGN

The existing configuration showing the 1.5 inch gap between the control building and the superheater building at Elevation 72'-0" is illustrated in Figure 4-1. It is possible to expand the gap to approximately 3.5 inches by a number of methods. Clearances in excess of approximately 3.5 inches require modification of the steel frame of either the superheater building or the control building. A number of such methods were evaluated. All involved the installation of rubber pads and provided essentially the same dynamic characteristics.

The recommended method is probably the easiest and least costly method for installing the pads. It is presented in Figure 4-2. For this method, the present 1.5 inch gap is opened up to 3-3.5 inches or greater as needed to accommodate the pads and the new steel angle. The angle section is welded to the existing steel plate, and the wood blocking is placed on the angle.

It is not necessary that the rubber pads completely fill the gap between the two buildings. By leaving a small gap of up to approximately 1 inch between the concrete slab and the rubber pads, ground motions with accelerations of less than 0.18g would result in no interaction between the buildings. This value (0.18g) is greater than that for the DBE (0.15g). This may have some licensing advantage.

In this design, it is necessary to transfer the interaction loads from the rubber pads into the steel plate, into the metal decking, and finally into the control building steel structure. This requires fillet and puddle welds as noted on Figures 4-2. The advantage of retaining the existing superheater slab overhang dimensions as shown in Figure 4-2 can only be utilized if adequate puddle welds exist for the metal deck to control building frame.

4.2 DESIGN CAPACITIES AND SPECIFICATIONS

The capacity of this buffer system will be limited by the shear capacity of the puddle welds connecting the control building metal decking to the supporting beam. This capacity is based on the thickness of the metal decking. Table 4-1 presents maximum allowable shears in pounds per linear foot of decking on marginal puddle welds that are spaced one foot apart (Reference 9). These allowable shears were determined from tests to determine the ultimate capacity of the welds. The ultimate capacity was then typically divided by a factor assumed to be approximately 3 to determine a safe allowable load. Therefore, the ultimate capacity of the puddle welds may be expected to be at least 3 times the values shown in Table 4-1. To determine the total capacity of the system, it is necessary to multiply the ultimate capacity per linear foot of deck by the length over which the load is transferred from the decking to the beam. This is assumed to be the full length of the control building, approximately 100 feet. Table 4-2 presents the maximum load capacities calculated in this manner. Also presented in Table 4-2 are the median ground accelerations that are expected to produce these forces. These accelerations are based on the forces calculated using the superheater building model with added masses. These accelerations have an expected random lognormal standard deviation of 0.22 and a lognormal standard deviation of approximately 0.2 for uncertainty.

4.3 DESIGN SPECIFICATIONS

Figure 4-3 shows a typical rubber shipping container mount recommended for the installation (Reference 10). Either part no. 29711-3A or 29711-4A could be used. To obtain a total compressive stiffness of 500 k/in, 85 of the former spaced at 14 inches on center or 66 of the latter spaced at 18 inches on center would be required. The spacing is based on having 100 feet in which to place the mounts. For one method of installation, the 1/2-inch diameter stud would be cut off flush with the mount surface and each pad attached by four 3/8-inch bolts as shown in Figure 4-3. Alternatively, the pads can be attached by means of the single 1/2-inch bolt to the angle section and the 4-bolt stud mounting plate left intact. The angle section to which these mounts would be connected would be a 6x6x1/2 inch section. The angle section must be welded to the steel plates in such a manner as to ensure that, considering moments on the angle, the ultimate shear capacity of this weld exceeds the ultimate shear capacity of the puddle welds that connect the steel decking and its supporting beam. The same would be true for the welds between the steel plates and the metal decking. The puddle welds should be no smaller than 1/2-inch diameter and spaced no farther apart than 1 foot. This type of installation provides that the dynamic interaction loads are transmitted relatively uniformly across the roof span in order to develop the maximum capacity of the existing roof deck system. Fewer, stiffer mounts may also be utilized, provided the same overall force-displacement relationship is approximately retained.

TABLE 4-1

MAXIMUM ALLOWABLE SHEARS FOR MARGINAL PUDDLE WELDS SPACED 1 FOOT APART

METAL DECKING GAUGE	ALLOWABLE SHEAR (lb/ft)	ULTIMATE SHEAR CAPACITY (lb/ft)
16	1920	5760
18	1540	4620
20	1150	3450
22	960	2880

TABLE 4-2

MAXIMUM TRANSFERABLE FORCES AND MEDIAN GROUND ACCELERATIONS THAT PRODUCE THESE FORCES

METAL DECKING GAUGE	MAXIMUM FORCE (kips)	MEDIAN PGA
16	576	1.3 g
18	462	1.1 g
20	345	1.0 g
22	288	0.90 g

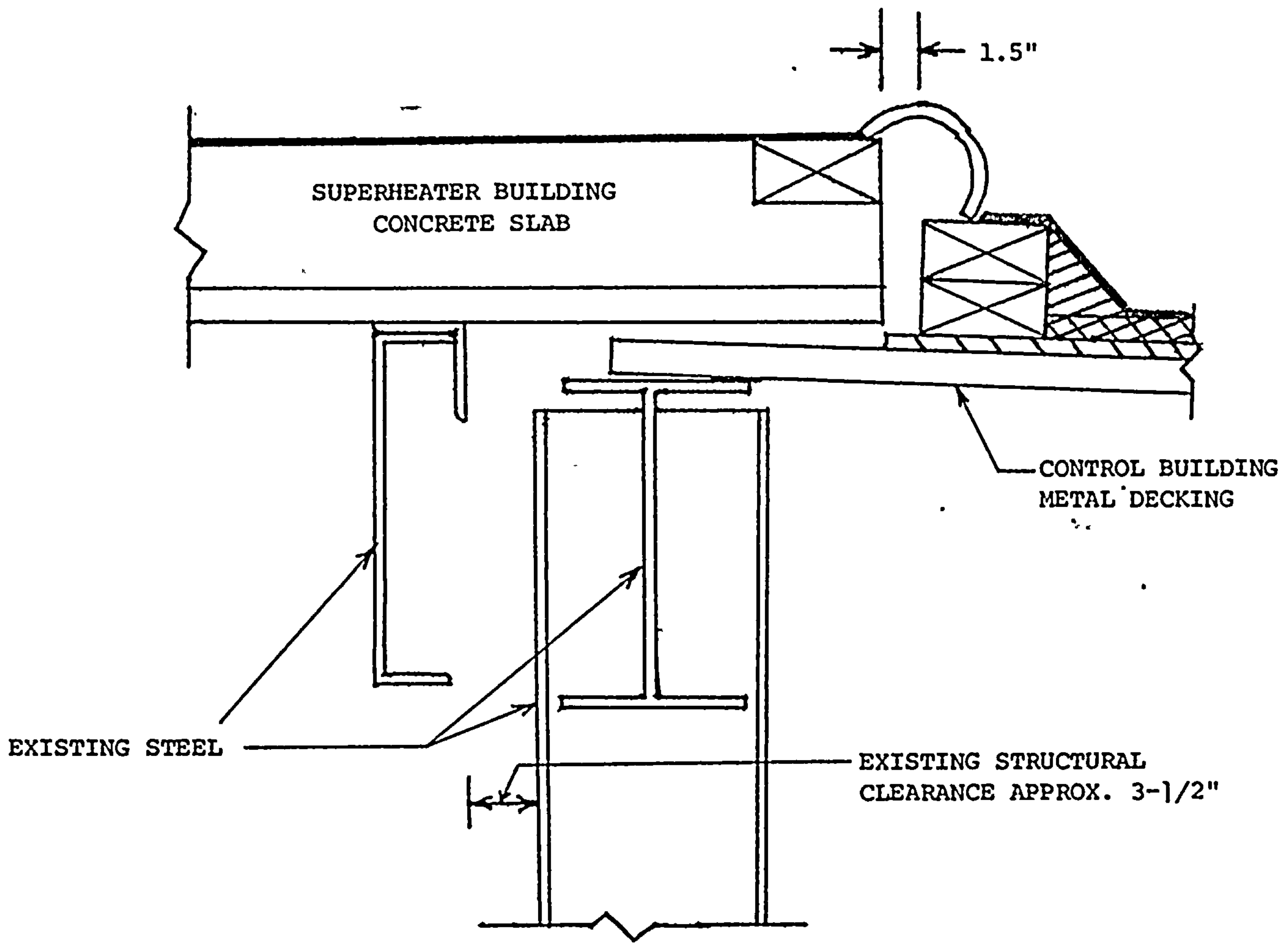


FIGURE 4-1. EXISTING CONFIGURATION OF CONTROL BUILDING AND SUPERHEATER BUILDING AT ELEVATION 72'-0"

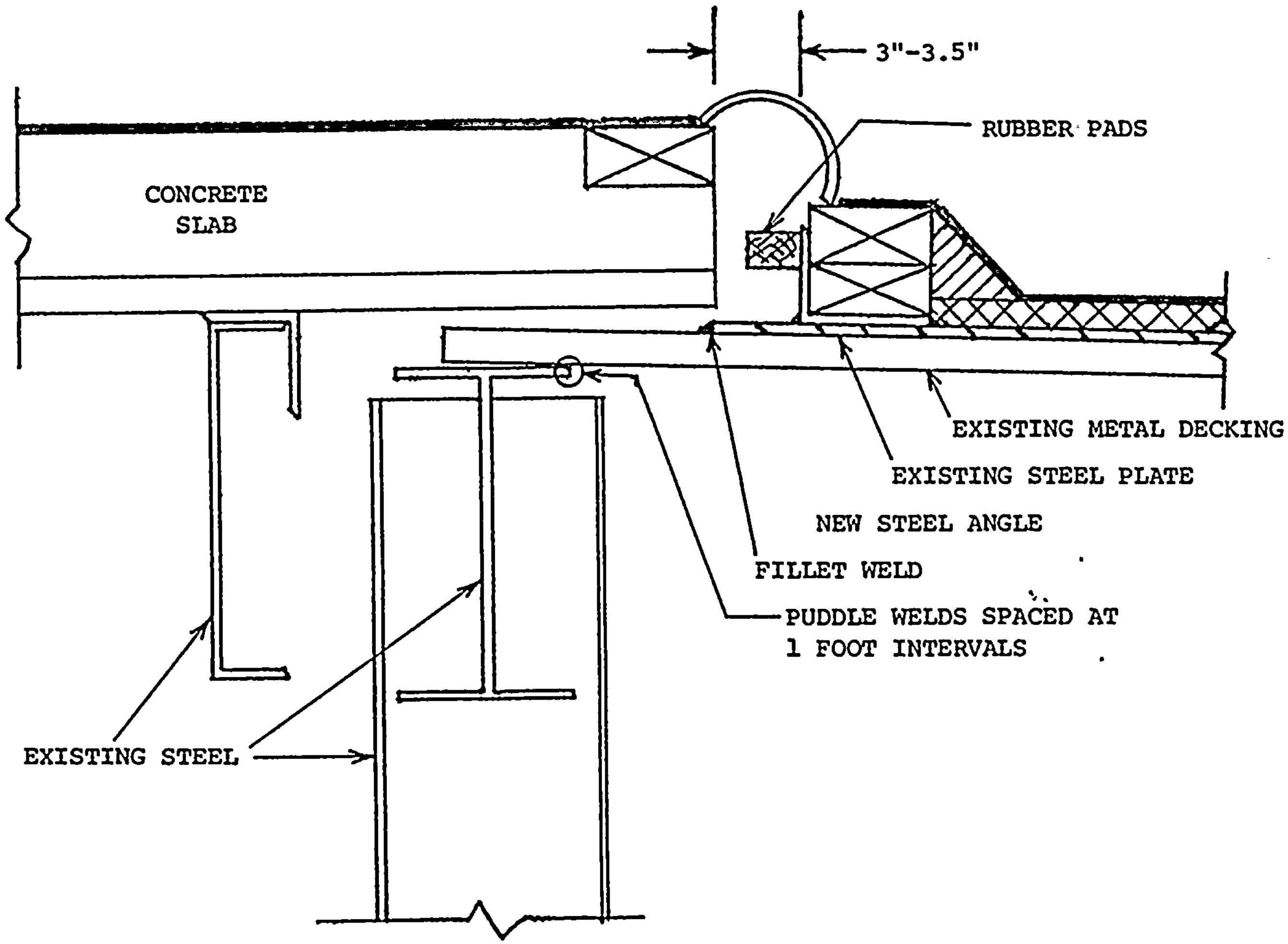
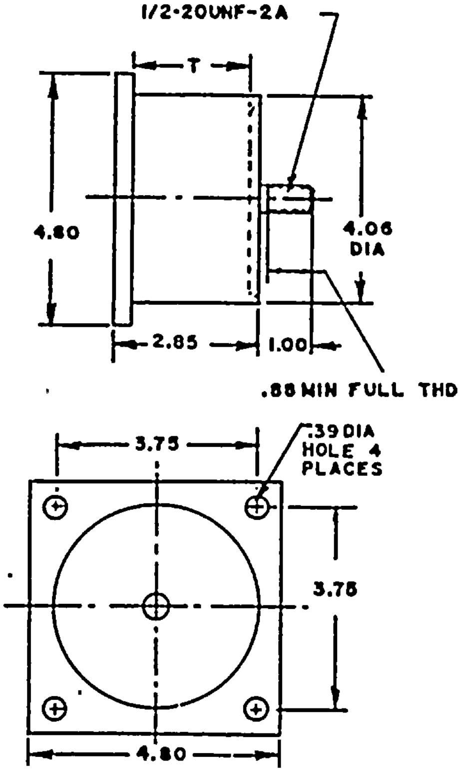
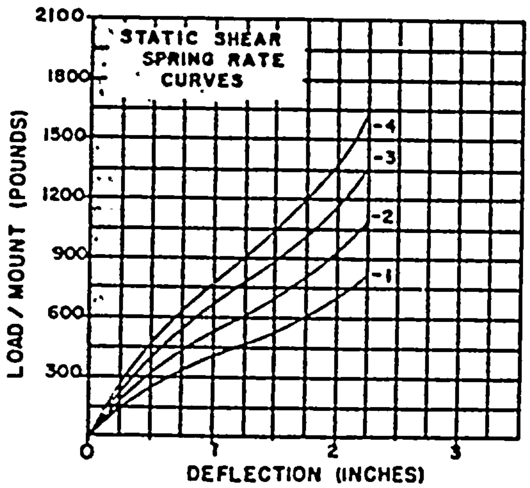


FIGURE 4-2. RECOMMENDED METHOD FOR ADDING RUBBER PADS BETWEEN CONTROL BUILDING AND SUPERHEATER BUILDING





MOUNT DATA

MATERIAL: LT

OPER. TEMP RANGE*
-65 °F TO 160 °F

KCOMP/KSHEAR 5 (APPROX)

TRANSMISSIBILITY AT RESONANCE (FORCED VIBRATION) 4.5 (APPROX)

METALS: STL-ZINC PLATE

*RANGE FOR EFFECTIVE SHOCK ISOLATION

K (DYNAMIC STIFFNESS)	570 LBS/IN	830 LBS/IN	1170 LBS/IN	1500 LBS/IN
T (SHEAR THICKNESS)	2.37 IN	2.37 IN	2.37 IN	2.37 IN
PART NO.	29711 -1A	29711 -2A	29711 -3A	29711 -4A

FIGURE 4-3. POSSIBLE RUBBER PAD LOAD CHARACTERISTICS

5. SUMMARY AND RECOMMENDATIONS

An assessment of the probabilities of seismic induced failures of the Indian Point Unit 2 nuclear facility (Reference 1) identified impact between the roof of the Unit 2 control building and the Unit 1 superheater building as a potential seismic failure mode for ground motions with accelerations in excess of approximately 0.27g. There are several possible methods of increasing the seismic capacity for this impact mode. This report dealt with the most promising of these methods which consists of increasing the current 1.5 inch gap between the two buildings to create a gap of 3-3.5 inches and inserting rubber pads in this gap to act as impact absorbers.

In order to evaluate the effects of these pads, mathematical two-dimensional models of the control building and the superheater building were created. The compression stiffnesses of the rubber pads were lumped together in one spring connecting the two models. Linear analyses were performed on these models in order to obtain an appropriate total spring stiffness. An artificial ground motion and two real earthquake records provided the input for these analyses. Due to the fact that the pads would only be attached to one building (and, hence, never be in tension) and that rubber becomes stiffer as it is compressed, it was necessary to conduct several nonlinear analyses taking the above into account. These analyses were performed using real earthquake records. Runs were made with the ground acceleration scaled to 1.0g and 1.2g. These analyses verified the spring stiffness chosen by the linear analyses.

A brief analysis of the control building roof established the puddle weld connections between the metal decking and the underlying support beam as the controlling factor in establishing the ultimate capacity of this system. Several capacities based on the metal decking thickness have been determined. Ground accelerations that would produce these forces have been calculated. These range from 0.90g to 1.3g.

Several possible design methods were evaluated and the recommended method is discussed. Typical rubber pads have been selected that would conform to the analyses, and design specifications for their installation have been detailed. Other specifications are listed that would ensure that the puddle weld connections would control the ultimate capacity.

REFERENCES

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4. "Final Report, Seismic and Tornado Analysis of the Super Heater Building, Unit No. 1, Indian Point", Westinghouse Electric Corporation, PWR Systems Division, NSD-E-WL-1707, Pittsburgh, Pennsylvania, October, 1970.

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APPENDIX B

INDIAN POINT 2 FIRE RISK RELATED MODIFICATIONS

B.1 INTRODUCTION

In the Indian Point 2 fire analysis, contained in the Indian Point Probabilistic Safety Study (IPPSS) (Section 7.3.1 of Reference B-1) the overall risk due to fires is found to be dominated by two fire zones: (1) the switchgear room, and (2) the electrical tunnel. In this appendix, the risk effects of a plant modification to reduce the frequency of fire initiated core melt events is evaluated.

The fire scenarios originating in those zones proceed through these stages: occurrence, propagation, and extinguishment of the fire itself, and the impact of the fire on the safety components. Modifications can be proposed to affect one or more aspects of fire occurrence and lead to reduction in the overall fire risk. The most effective modification is the installation of additional transfer switches in the already existing alternate shutdown system (ASDS) and relocating of the alternate pneumatic indicators for steam generator levels and pressurizer level and pressure to outside the containment. The additional transfer switches would facilitate a quicker connection to an alternate power source for one train of component cooling pumps, charging pumps, and service water pumps.

The dominant fire scenario in the IPPSS (Section 7.3.1) is loss of the component cooling system (CCS) and the normal charging system (CVCS) (due to power cable failure) and loss of all mitigating systems. A small LOCA via reactor coolant pump (RCP) seal failure results from CCS and charging system failure.

To quantify the frequencies of core melt and release categories after the modification is completed, we need a more detailed list of contributors for the IPPSS. This is because, when the dominant contributors are reduced, other formerly noncontributing areas may gain importance. The IPPSS frequencies are reviewed in Section B.2.

The different aspects of a fire incident are analyzed in Section B.3. The details of the modification and all the necessary assumptions for evaluating the impact of this modification are given in Section B.4. The impact of the modification is evaluated in Section B.5. The results are summarized in Table B-1.

B.2 IPPSS FIRE RISK

The IPPSS fire risk results are needed for: (1) choosing the type of modification; and (2) measuring the reduction in the frequencies of core melt and release categories. In Section 7.3.1 of the Indian Point Probabilistic Safety Study, these frequencies are calculated in terms of the dominant contributors. Most of the fire zones were not explicitly analyzed quantitatively, judging that their contribution would be insignificant. Typically, these fire zones contained only a few safety related components. The proposed modification would certainly change the pattern of contributors to the release categories and core melt. The fire risk from all fire zones not explicitly quantified in the IPPSS are now so quantified. Table B-2 summarizes the results and Section B.6 gives the details. The fire zone designating numbers are taken from Reference B-2. All the areas that contain some safety components per Reference B-2 are included here. The results of Section 7.3.1 of the IPPSS are directly used in Table B-2. For areas not originally quantified in Section 7.3.1 of the IPPSS, point values (mean frequencies) are estimated per formulations given in Section B.6. The fire zones analyzed in Section 7.3.1 of the IPPSS are found to be (as expected) the dominant contributors to core melt and damage states SE and TE. However, the mean frequency of other damage states are found to be dominated by fire zones not explicitly quantified in Section 7.3.1. Two comments are in order here. First, the increased frequency of these damage states has very little impact on the overall frequency of the damage states. The IPPSS mean frequency of release category 8A increases from 4.8×10^{-5} per reactor year (from Table 8.3-2 of the IPPSS) to 4.9×10^{-5} per reactor year. Second, the main contributors to this increase are computed by conservative methods, and a more rigorous evaluation is expected to yield smaller frequencies and an overall 8A frequency very close to that presented in the IPPSS. The overall IPPSS mean frequency of release category 8B is 9.1×10^{-5} per reactor year (from Table 8.3-2 of the IPPSS) and is significantly larger than 1.8×10^{-5}, the new frequency of 8B due to fires. The latter is now dominated by contributions from fire zones that were not explicitly quantified in Section 7.3.1 of the IPPS. In Section B.6, we find that many conservative measures are incorporated in the quantification of these dominating fire zones.

B.3 BASIS FOR MODIFICATION

In this section, the basis for the proposed modification is examined. A typical quantification process for a critical fire area can be written as

$$\phi_{Damage} = \lambda_{Fire} Q_{Plant}$$

where λ_{Fire} represents fire phenomenology and Q_{Plant} represents the

impact of fire on accident sequences. By fire phenomenology we mean the occurrence of fire in critical areas, its propagation to vital components, and failure of extinguishment features to put out the fire in time to prevent the failure of vital components. The conditional frequency (given the fire) Q_{Plant} represents the frequency of failure of vital components, the frequency of failure in restoring a failed component, and the unavailability of components independent from fire. The frequency of fires is obtained from statistical data.

Plant response to a fire incident can be altered by introducing new equipment or new power sources to existing equipment. In the IPPSS (Section 7.3.1), we find that there are two important areas (the switchgear room and the electrical tunnel) through which the power cables of almost all vital components are routed. Also, we find that the dominant accident sequence is a small LOCA via RCP seal failure and multiple loss of engineered safeguards. If seal failure can be prevented, core melt due to other initiating events (we have assumed a reactor trip as the enveloping initiating event) would depend on the availability of the turbine-driven or a motor-driven auxiliary feedwater pump. The turbine-driven pump can be started and brought up to speed independent of the switchgear room or the electrical tunnel. A motor-driven auxiliary feedwater pump can be powered from the alternate shutdown system.

In Section 7.3.1 of the IPPSS, we find that the existing alternate shutdown system configuration does not provide adequate protection to prevent RCP seal failure. This is because to power a charging pump and/or a component cooling pump from the alternate shutdown source, a cable (or cables) must be run from disconnect switch(es) near the pump(s), replacing the original power cable(s). The process was judged to take longer than a half hour, thereby not preventing RCP seal failure. It should be noted that the half hour is the conservatively assumed time to RCP seal failure in the absence of seal water injection and thermal barrier cooling.

The process can be expedited by installing fixed alternate cabling and transfer switches and connecting both normal and alternate power cables to the switches. The operators can then switch to the alternate shutdown system by simply throwing the transfer switches. If the seal failure is prevented, the plant can be safely shut down using the secondary side cooling features. However, it is necessary to monitor the steam generator levels and pressurizer level and pressure. It is proposed that the existing alternate pneumatic indicators for these parameters be relocated outside the containment. More details about this modification are given in the following section.

B.4 DESCRIPTION OF MODIFICATION

The most effective modification is the installation of transfer switches for one train of service water pumps, charging pumps, and component cooling pumps and relocating pneumatic level and pressure indicators outside the containment. The switches will allow an operator to transfer the power source for these pumps to the Indian Point Unit 1 switchgear within the first half hour of an accident that disables the component cooling and charging pumps. Figure B-1 shows the transfer switch that is already installed for a motor-driven auxiliary feedwater pump. It is assumed that the proposed ones will be very similar to this one.

This modification is judged to be the most effective because it complements another major modification, the alternate shutdown system installed previously. It does not require major rewiring of power or control circuits or installation of new major components.

The alternate shutdown system is described in Reference B-3. It uses Indian Point Unit 1 switchgear and power cables are run to supply at least one service water pump, one motor-driven auxiliary feedwater pump, one component cooling pump, and one charging pump. With the proposed modification, the operators can transfer the power source of the dedicated pumps by manually throwing a switch near the pump location. Of course, they have to load the Unit 1 switchgear (which must be accomplished locally) prior to engaging the transfer switch(es). The power cables of the alternate shutdown system are routed through areas independent from the switchgear room, the electrical tunnel, the cable speading room, the control room, containment spray pump room (fire zone 2), and the primary makeup pump area (fire zone 2B). It is assumed in this analysis that the procedures will be modified to address the addition of the new switches and the system will be functionally tested prior to service. Furthermore, as part of this modification, the pneumatic indicators installed near the airlock in the containment for steam generator level and pressurizer level and pressure will be relocated to outside the containment.

B.5 FIRE RISK AFTER THE MODIFICATION

The modification impacts mainly those fire scenarios such as fires in the electrical tunnel or switchgear room where many vital components may be affected. Table B-3 summarizes the results in terms of mean frequencies of the contributions from all fire zones. The modification has reduced the contributions from the electrical tunnel, the switchgear room, and the containment spray pump area. The other fire areas are either not affected by the modification or the impact is insignificant.

B.5.1 AREAS NOT AFFECTED

The cable spreading room and the control room fire scenarios are not significantly affected because the IPPSS included provisions for the alternate shutdown system (before the proposed modification). In those scenarios, credit is given to the operators reactivating normally running components such as a charging pump and a component cooling pump provided that they are inadvertently stopped by a fire. Inadvertent stoppage of these pumps due to fire is deemed to be a comparatively lower frequency event. Thus, the possibility of an RCP seal failure (small LOCA) is not analyzed. It should be noted that in a cable spreading room or control room fire, only control and instrumentation circuits are affected. Even if it is assumed that all indications are lost, the operators can use the existing pneumatic indicators and activate the pumps from the switchgear room to safely shut down the plant.

The modification cannot have a significant impact on the contribution from pump rooms such as fire zone 1 for CCS pumps or zone 9 for the SI pumps. For these cases, the fire will disable all power feeds to the pumps or the pumps themselves, thus the fire would render the proposed transfer switch ineffective. For the remaining areas, the modification cannot help the restoration of the affected system because the components within those areas are not powered by the alternate shutdown system.

B.5.2 IMPACT ON SWITCHGEAR ROOM CONTRIBUTION

The main impact of the proposed modification on a switchgear room fire is decreasing the likelihood of an RCP seal LOCA. In a switchgear room fire, if both switchgear cabinets or the power cables are affected, the power to all CCS pumps and charging pumps would be lost. With the proposed modification, the operators can activate switchgear of Unit 1 (which has to be done locally) and throw the transfer switches of the CCS pump and/or the charging pump and reactivate the RCP seal cooling function. The relevant valves would be in their normal operating position and it is deemed very unlikely for the switchgear room fire to cause inadvertent closure of these valves. The transfer to the Unit 1 switchgear has to be completed within the first half hour of loss of all RCP seal cooling.

The conditional frequency, Q_{S1}, of seal LOCA given a large fire in the switchgear room can then be written as

$$Q_{S1} = Q_{HE,S1} + Q_{SW} + Q_{CCS}$$

where

$Q_{HE,S1}$ ≡ human error; failure of the operators to reactivate the CCS pump within one half hour.

Q_{SW} ≡ failure of the transfer switch.

Q_{CCS} ≡ failure of the component cooling pump.

and

$$Q_{CCS} = Q_{CCS,D} + 24\lambda_{CCS} + Q_{CCS,M}$$

where

$Q_{CCS,D} \equiv$ failure of the CCS pump on demand.

$\lambda_{CCS} \equiv$ failure of the CCS pump during operation (per hour).

$Q_{CCS,M} \equiv$ unavailability of CCS pump due to maintenance.

The total time period that the component cooling pump is needed to operate is taken to be 24 hours.

The main contributor to $Q_{HE,S1}$ is judged to be failure of the control room operators to initiate the process for transferring to the alternate shutdown system. The large fire in the switchgear room is judged to pose a medium to high stress level on the operators. There will be at least three operators involved in making the decision. Reference B-4 gives human error frequencies and has defined levels of dependency among the operators. It is judged that one of the operators will be strongly dependent on the other two and the level of dependence of the other two on one another will be low. Reference B-4 suggests 0.1 for the frequency of human error for one operator under very high levels of stress. For the conditional frequency of a second operator making the same error, Reference B-4 suggests a point value of 0.15. Based on these suggested frequencies, we have chosen $Q_{HE,S1}$ to be lognormally distributed with the following characteristic values

$$Q_{HE,S1,05} = 9.0 \times 10^{-3}$$

$$Q_{HE,S1,50} = 3.0 \times 10^{-2}$$

$$Q_{HE,S1,95} = 1.0 \times 10^{-1}$$

$$\alpha_{Q_{HE,S1}} = 3.9 \times 10^{-2}$$

Table B-4 gives the frequencies of Q_{SW}, $Q_{CCS,D}$, λ_{CCS} and $Q_{CCS,M}$. Using those frequencies and the previously given human error frequency the conditional frequency of seal LOCA is evaluated. Its characteristic values are:

$$Q_{S1,05} = 1.7 \times 10^{-2}$$

$$Q_{S1,50} = 3.7 \times 10^{-2}$$

$$Q_{S1,95} = 9.8 \times 10^{-2}$$

$$\alpha_{Q_{S1}} = 4.6 \times 10^{-2}$$

In a large switchgear room fire, all the small LOCA mitigating functions will be lost. Thus, if a seal LOCA occurs, the operators have to turn on at least one auxiliary feedwater pump and at least one SI pump. The turbine-driven auxiliary feedwater pump is independent of the switchgear room. A motor-driven auxiliary feedwater pump can be activated using the alternate shutdown system. However, the SI pumps would be affected by the fire and would not be available within 1 hour of seal failure.

Thus, core melt is taken to be certainty in the case of seal failure. The conditional frequency of core melt $Q_{CM,14}$ can then be written as

$$Q_{CM,14} = Q_{S1}$$

The characteristic values of $Q_{CM,14}$ are:

$$Q_{CM,14,05} = 1.7 \times 10^{-2}$$

$$Q_{CM,14,50} = 3.7 \times 10^{-2}$$

$$Q_{CM,14,95} = 9.8 \times 10^{-2}$$

$$\alpha_{Q_{CM,14}} = 4.6 \times 10^{-2}$$

The containment spray pumps and containment fan cooler units will be lost in a switchgear room fire. The alternate shutdown system does not have any provisions for restoring the power to these components. Thus, a core melt due to seal failure would lead to plant damage state SE. The unconditional frequency of damage state SE is then

$$\phi'_{SE,14} = \phi_{SE,14}\, Q_{CM,14}$$

where $\phi_{SE,14}$ is the base case frequency of state SE due to switchgear fires given in the IPPSS.

If the seal failure is prevented, the initiating event becomes a transient (reactor trip is assumed here). Safe shutdown can be achieved if the AFWS or bleed and feed mode of core cooling is employed. The latter is not possible because the PORV block valves would be lost due to loss of both safety MCCS 26A and 26B. Also, there is no immediate power to SI pumps. Of the auxiliary feedwater system, either the turbine-driven pump or one motor-driven pump (by connecting to the alternate shutdown system) can be used. The conditional frequency, $Q_{CM,T}$, of core melt (given a large switchgear room fire and successful RCP seal cooling or injection) is then equal to the unavailability of AFWS. It is deemed that human error contribution is very small because the successful alignment of CCS and charging pumps would have a reassuring effect on the operators. The unavailability of AFWS due to other causes as evaluated in Section 1.5.2.3.9 of the IPPSS is used here. The distribution is approximated by a lognormal distribution with the following characteristic values:

$$Q_{CM,T,14,05} = 4.7 \times 10^{-5}$$

$$Q_{CM,T,14,50} = 1.3 \times 10^{-4}$$

$$Q_{CM,T,14,95} = 3.6 \times 10^{-4}$$

$$\alpha_{Q_{CM,T,14}} = 1.6 \times 10^{-4}$$

Then the unconditional frequency of damage state TE becomes:

$$\phi'_{TE,14} = \phi_{SE,14}\, Q_{CM,T,14}$$

The base case frequency of damage state SE is used because it is equal to the frequency of large fires in the switchgear room. The mean of the frequency of damage state TE after the proposed modification is given in Table B-3.

B.5.3 IMPACT ON ELECTRICAL TUNNEL CONTRIBUTION

B.5.3.1 Fire at the Right Stack of Trays

The electrical tunnel contribution is also affected by the proposed modification. If the fire affects only the right stack of trays, damage states SEF and SLF would result (in this study we only use SEF and include all SLF contributions in SEF). The operators can prevent seal failure as described earlier. The conditional frequency of failure to prevent seal LOCA is Q_{S1} which was evaluated earlier.

In the base case evaluation of fire risk, the electrical tunnel is evaluated in two parts: (1) fire zone 1A on the PAB side, and (2) 32A on the control building side. The unconditional frequencies of SEF due to fire in these areas can be written as:

$$\phi'_{SEF,1A} = \phi'_{SEF,32A} = (\phi_{SEF,1A} + \phi_{SLF,1A})\, Q_{S1}$$

This equation reflects the fact that base case SEF and SLF frequencies of the portions of the tunnel are equal. The mean values are given in Table B-3.

If the seal failure is prevented, the initiating event becomes a transient (reactor trip is assumed here). Safe shutdown can be achieved if the AFWS or bleed and feed mode of core cooling is employed. The two safety MCCs will be failed in a fire in the right stack of trays. Thus, the PORV block valves will not be able to be opened for bleed and feed, and similar to the switchgear room fire, if AFWS is not activated core

melt could occur. The auxiliary feedwater system is independent from this fire. From Section 1.5.2.3.9 of the IPPSS the unavailability of AFWS is obtained. It is approximated with a lognormal distribution with the following characteristic values:

$$Q_{CM,T,ET,05} = 1.7 \times 10^{-6}$$

$$Q_{CM,T,ET,50} = 1.1 \times 10^{-5}$$

$$Q_{CM,T,ET,95} = 6.5 \times 10^{-5}$$

$$\alpha_{Q_{CM,T,ET}} = 1.9 \times 10^{-5}$$

The containment spray system would also fail from a fire in the right stack of trays. Thus, the unconditional frequency of TEF becomes

$$\phi'_{TEF,1A} = \phi'_{TEF,32A} = \lambda_{AUX} f_T f_R Q(\tau_V)\ Q_{CM,T,ET}$$

where

λ_{AUX} = frequency of fires in the PAB, the control building (CB) or the fan house (FH).

f_T = fraction of PAB, CB and FH fires that occur in the electrical tunnel in the PAB.

f_R = fraction of electrical tunnel fires that occur in the right stack of trays.

$Q(\tau_V)$ = conditional frequency of fire propagation.

These parameters are evaluated in Section 7.3.1.4 of the IPPSS and they are summarized in Table B-4. The mean frequencies of damage state TEF after the proposed modifications are given in Table B-3.

B.5.3.2 Fire Affecting Both Stacks of Trays

If the fire affects both stacks of trays, from the base case study, damage state SE would result. The seal failure may be prevented using the modified alternate shutdown system. The conditional frequency of seal failure is again Q_{S1}. Thus, the unconditional frequency of damage state SE becomes:

$$\phi'_{SE,1A} = \phi_{SE,1A} Q_{S1}$$

$$\phi'_{SE,32A} = \phi_{SE,32A} Q_{S1}$$

If seal failure is prevented, a transient (we assume reactor trip) would occur. The bleed and feed mode of core cooling would not be available because the two safety MCCs would be lost. Two trains of AFWS can be made available manually. Similar to switchgear room fire, it is deemed that human error contribution is very small because the successful alignment of CCS and charging pumps would have a reassuring effect on the operators. The unavailability of AFWS due to other causes as evaluated in Section 1.5.2.3.9 of the IPPSS is used here. Using the results from the switchgear room fire study, we write

$$Q_{CM,T,1A} = Q_{CM,T,32A} = Q_{CM,T,14}$$

and for the unconditional frequencies

$$\phi'_{TE,1A} = \phi_{SE,1A} Q_{CM,T,1A}$$

$$\phi'_{TE,32A} = \phi_{SE,32A} Q_{CM,T,32A}$$

The mean frequencies of damage state TE after the proposed modifications are given in Table B-3.

B.5.4 IMPACT ON CONTAINMENT SPRAY PUMP AREA, FIRE ZONES 2 AND 2A

The power cables of all CCS pumps are routed through these two fire zones, where the containment spray pumps, the primary water makeup pumps and the spray additive tank are located. Since the transfer switch and the power cable for one CCS pump from the alternate shutdown system would not be located in these areas, there is a very small likelihood for a single fire or coincident fires simultaneously affecting the contents of these fire zones and failing the power source transfer capability.

One component cooling pump can be made available manually by transferring the power source to the alternate shutdown system, thus preventing seal failure. The conditional frequency, Q_{S1}, which was evaluated earlier in this appendix is also applicable here. The frequencies of damage states SEF and SE are reduced by Q_{S1}. Table B-3 shows the mean values. For damage state SEF, the unavailability of CCS is reduced by Q_{S1}. For damage state SE, the unavailabilities of CCS and service water system (SWS) are reduced by Q_{S1}.

B.5.5 IMPACT ON THE RELEASE CATEGORIES DUE TO FIRE

Three release categories, 8B, 8A, and 2RW may result from a fire incident. Their frequencies of occurrence are evaluated from the major contributors as determined by the mean values of Table B-3. The results are summarized in Table B-1.

The frequency of release category 8B is dominated by the frequency of damage state TEC from fire zone 74A (electrical penetration area), by the frequency of damage state TEFC from fire zone 23 (auxiliary boiler feed pump room), and by damage state TEFC from fire zone 11 (the cable spreading room).

$$\phi'_{8B} = \phi_{TEC,74A} + \phi_{TEFC,23} + \phi_{TEFC,11} = \lambda_{AUX} f_T Q(\tau_H)\, Q_S$$

$$+ \lambda_{AUX} f_1 (Q_{SI} + Q_{REC} + Q_{PORV}) + \lambda_{CSR} f_{ES} Q(\tau_G)\, Q_S\, Q_{HE}$$

All the parameters of this equation (such as λ_{AUX}, f_T, etc.) are defined and evaluated either in Section B.6 of this report or in Section 7.3.1 of the IPPSS. The characteristic values of release category 8B after the proposed modifications are given in Table B-1.

The frequency of release category 8A from fires is dominated by the frequency of damage state SEF from fire zones 1A and 32A (both portions of the electrical tunnel).

$$\phi'_{8A} = \phi'_{SEF,1A} + \phi'_{SEF,32A} = 2\phi'_{SEF,1A}$$

$$= 2(\phi_{SEF,1A} + \phi_{SLF,1A})\, Q_{S1}$$

The base case frequencies $\phi_{SEF,1A}$ and $\phi_{SLF,1A}$ are taken from Section 7.3.1 of the IPPSS. The parameter Q_{S1} is evaluated earlier in this section. The characteristic values of release category 8A after the proposed modifications are given in Table B-1.

The frequency of release category 2RW from fires is dominated by the frequency of damage state SE from fire zones 1A and 32A (both portions of the electrical tunnel), fire zone 14 (the switchgear room), and by the frequency of damage state TE from fire zone 11 (the cable spreading room).

$$\phi'_{2RW} = \phi'_{SE,1A} + \phi'_{SE,32A} + \phi'_{SE,14} + \phi'_{TE,11}$$

$$= \lambda_{AUX} f_T f_A [1 + Q(\tau_A)] Q_{S1} + \lambda_{AUX} f_{SWG} f_{SL} Q(\tau_G) Q_{CM,14}$$

$$+ \lambda_{CSR} f_{ES} Q(\tau_G) Q_S Q_{HE}$$

All the parameters of this equation (such as λ_{AUX}, f_T, etc.) are defined and evaluated either in this Appendix or in Section 7.3.1 of the IPPSS. The characteristic values of release category 2RW are given in Table B-1.

The frequency of core melt from fires is now dominated by the frequency of damage state TEC from fire zone 74A (the electrical penetration area), the frequency of state TEFC from fire zone 23 (the auxiliary boiler feed

pump room), the frequencies of damage states SEF and SE from fire zones 1A and 32A (both portions of the electricl tunnel) and by the frequency of damage state TEFC from fire zone 11 (the cable spreading room).

$$\phi'_{CM} = \phi'_{TEC,74A} + \phi'_{TEFC,23} + \phi'_{SEF,1A} + \phi'_{SEF,32A} + \phi'_{SE,1A}$$

$$+ \phi'_{SE,32A} + \phi'_{SE,14} + \phi_{TEFC,11}$$

All the parameters of this equation have been defined earlier in this section. Thus, the characteristic values of the core melt frequency after the fixes are given in Table B-1.

B.6 HIGHLIGHTS OF THE IPPSS QUANTIFICATION

In this section, the methods used for calculating the risk from the fire zones not explicitly quantified in Section 7.3.1 of the IPPSS are described. The details of quantification for some areas are also highlighted.

B.6.1 THE GENERAL FORMULATIONS

In Section 7.3.1 of the IPPSS, it is found that fires cannot cause a large or medium LOCA. The simultaneous occurrence of these initiating events and a fire disabling part or most of the mitigating systems can be shown to be dominated by the frequencies of these sequences due to causes other than fire.

For a small LOCA, it is found that fire can only lead to a reactor coolant pump seal failure (thereby leading to a small LOCA) and cannot cause any other type of breach in the primary system (Section 7.3.1 of the IPPSS). To simplify the calculations, the delayed melts (e.g., due to failure of the recirculation system) are combined with early melts. Core melt is computed in two parts: (1) core melt due to a small LOCA, and (2) core melt due to a transient. The transients are grouped together and reactor trip is chosen to be the representing transient initiating event.

$$\phi_{core\ melt} = \phi_{CM,small\ LOCA} + \phi_{CM,transient}$$

$$\phi_{CM,small\ LOCA} = \lambda_{Fire}[Q_{EP} + Q_{SW} + Q_{CCS}(Q_{SI} + Q_{REC} + Q_{CF} + Q_{PORV} + Q_{AFWS})]$$

$$\phi_{CM,transient} = \lambda_{Fire}[(Q_{SI} + Q_{REC} + Q_{PORV})Q_{AFWS}]$$

where

λ_{Fire} = frequency of fire failing a specified group of vital components.

Q_i = unavailability of system i.

EP = electric power system.

SW = service water system.

CCS = component cooling water system.

SI = safety injection system.

REC = recirculation system.

CF = containment fan cooling system.

PORV = power-operated relief valves (block valves are used for bleed and feed operation).

AFWS = auxiliary feedwater system.

The equation for core melt due a small LOCA is based on the event tree of Figure 7.3.1-6 of the IPPSS. The systems referenced previously are analyzed in Section 1.5.2 of the IPPSS, except for the PORV which is analyzed in Section 1.3.3.9 of the IPPSS. The unavailability of these systems is given in Section 1.5.2 for different boundary conditions. In that core melt equation, it is assumed that total loss of electric power or service water will lead to RCP seal failure and loss of all mitigating features. It is also assumed that total loss of component cooling leads to loss of the charging pumps and, consequently, a small LOCA via the RCP seals. The availability of the containment fan coolers determines the availability of the recirculation system when the component cooling system is not available.

The equation for core melt due to a transient is based on the event tree of Figure 7.3.1-7 of the IPPSS. The plant damage states are computed from the following equations:

$$\phi_{SEFC} = \lambda_{Fire}[Q_{CCS}(Q_{SI} + Q_{REC} + Q_{PORV}Q_{AFWS})]$$

$$\phi_{SEF} = \phi_{SEFC}Q_{CS}$$

$$\phi_{SEC} = \lambda_{Fire}[Q_{CCS}Q_{CF} + Q_{SW}]$$

$$\phi_{SE} = \lambda_{Fire}[Q_{EP} + Q_{SW}Q_{CS} + Q_{CCS}Q_{CF}Q_{CS}]$$

$$\phi_{TEFC} = \phi_{CM,transient}$$

$$\phi_{TEF} = \phi_{TEFC}Q_{CS}$$

$$\phi_{TEC} = \phi_{TEFC}Q_{CF}$$

$$\phi_{TE} = \phi_{TEFC}Q_{CF}Q_{CS}$$

where the different parameters are defined earlier and

Q_{CS} = unavailability of the containment spray system (this system is analyzed in Section 1.5.2 of the IPPSS).

The frequencies of the release categories are computed using

$$\phi_{8B} = \lambda_{Fire}[Q_{SW} + Q_{CCS}(Q_{SI} + Q_{REC} + Q_{CF}) + (Q_{SI} + Q_{REC} + Q_{PORV})Q_{AFWS}]$$

$$\phi_{8A} = \lambda_{Fire}[Q_{CCS}(Q_{SI} + Q_{REC}) + (Q_{SI} + Q_{REC} + Q_{PORV})Q_{AFWS}]Q_{CS}$$

$$\phi_{2RW} = \lambda_{Fire}[Q_{EP} + Q_{SW}Q_{CS} + Q_{CCS}Q_{CF}Q_{CS}$$

$$+ (Q_{SI} + Q_{REC} + Q_{PORV})Q_{AFWS}Q_{CF}Q_{CS}]$$

The mean of the frequency of λ_{Fire} is conservatively taken as 10^{-3} for each fire zone in the primary auxiliary building (PAB), the fan house (FH), the control building (CB), and the containment. For those areas in which the core melt and damage state frequencies are evaluated, this mean frequency is reevaluated using distributions of the frequency of fires in the overall building and the fraction of those fires occurring in the specific area.

Table B-5 gives the results and input information for core melt and damage state calculations. All five zones are addressed. The details of some of the calculations are highlighted hereafter.

B.6.2 FIRE ZONE 1, CCS PUMP ROOM

Fire zone 1 is located at Elevation 68' of the PAB. The three component cooling pumps are installed in this area. The frequency of failure of all three pumps due to a fire incident, λ_{Fire}, is shown as a fraction of auxiliary building fires

$$\lambda_{Fire} = \lambda_{AUX} f_1$$

In Section 7.3.1 of the IPPSS, we find:

$$\lambda_{AUX,05} = 0.015 \text{ ry}^{-1}$$

$$\lambda_{AUX,50} = 0.033 \text{ ry}^{-1}$$

$$\lambda_{AUX,95} = 0.053 \text{ ry}^{-1}$$

$$\alpha_{\lambda_{AUX}} = 0.034 \text{ ry}^{-1}$$

The fraction f_1 is the fraction of fires that may occur in fire zone 1 and be of sufficient severity to fail all three CCS pumps. It is evaluated judgmentally based on the experience gained in doing the

analysis of Section 7.3.1 of the IPPSS, and is chosen to be lognormally distributed with the following characteristic values:

$$f_{1,05} = 5.0 \times 10^{-4}$$

$$f_{1,50} = 5.0 \times 10^{-3}$$

$$f_{1,95} = 5.0 \times 10^{-2}$$

$$\alpha_{f_1} = 1.3 \times 10^{-2}$$

The product of these two distributions, λ_{Fire}, which is the frequency of fires in fire zone 1 that would fail all three CCS pumps, yields the following characteristic values (per reactor year):

$$\lambda_{Fire,05} = 1.6 \times 10^{-5}$$

$$\lambda_{Fire,50} = 0.9 \times 10^{-4}$$

$$\lambda_{Fire,95} = 1.7 \times 10^{-3}$$

$$\alpha_{\lambda_{Fire}} = 4.4 \times 10^{-4}$$

The mean unavailabilities of the mitigating systems are taken from Section 1.5.2 of the IPPSS. The formulations given in Section B.6.1 are used to evaluate the core melt and other plant damage states.

B.6.3 FIRE ZONE 15, CONTROL ROOM

The control room is directly above the cable spreading room and contains the control and instrumentation cables, controls, and readouts of virtually all the systems of the plant. There are no motive power cables in the area. The area is manned continuously. There are fire detectors inside the control cabinets. The fire extinguishment capability for the area consists of two hose stations and a class A fire extinguisher adjacent to the zone and several 15-pound carbon dioxide extinguishers inside the control room. The operators also have access to breathing apparatus that can be used in case of smoke in the area.

The most critical area within the control room is the control cabinet of safety components (cabinet numbers SB1 and SB2) which are directly above the critical area in the cable spreading room that was analyzed in Section 7.3.1 of the IPPSS. A fire in these cabinets would have the same impact on plant safety as a cable spreading room fire at the center of the northern wall. However, in this case, the operators would detect the fire almost immediately and attempt to extinguish it in a short period of time. Also, the transient fuels in the control room are judged to be significantly less than the cable spreading room. Not all control room fires would lead to the evacuation of the area because operators can wear breathing apparatus and the control room HVAC can purge the contaminated control room air.

Fires affecting cabinets other than those controlling the safety components (i.e., SB1 and SB2) will not have severe impact on the plant's safety margin. A fire affecting SB1 and SB2 will result in accident sequences similar to those analyzed for cable spreading room fires in Section 7.3.1.2.4 of the IPPSS. It is judged that the frequency of core melt or other damage states from control room fires is just a fraction of the frequency of the same state from cable spreading room fires. This fraction, f_{CR}, is judged to have the following histogram:

f_{CR}	Probability	Cumulative Probability
0.01	0.05	0.05
0.03	0.20	0.25
0.10	0.25	0.50
0.30	0.25	0.75
0.75	0.20	0.95
1.00	0.05	1.00

The mean of this distribution is 0.31. For example, the core melt frequency from control room fires is obtained from

$$\phi_{CM,CR} = f_{CR}\phi_{CM,CSR}$$

where

$\phi_{CM,CSR}$ = core melt frequency from cable spreading room fires.

The mean frequencies are given in Table B-5.

B.6.4 FIRE ZONE 27A, CORRIDOR

This corridor at Elevation 98' of the primary auxiliary building contains the safety related motor control centers 26A and 26B. The controls of all safety related motor-operated valves pass through these motor control centers. It is a controlled access area. Considering the frequency of fires in other areas and the fire propagation analysis performed for other areas, the frequency of failing both of the motor control centers is written as

$$\lambda_{Fire} = \lambda_{AUX} f_{27A} f_{PF}$$

where

λ_{AUX} = frequency of auxiliary building fires.

f_{27A} = the fraction of auxiliary building fires that may occur at the motor control center area.

f_{PF} = the fraction of motor control center area fires that may occur between the two safety cabinets and be large enough to fail both of them.

The fraction, f_{27A}, of auxiliary building fires in the motor control center area is assessed by comparing two similar parameters for the switchgear area, f_{SWG}, and electrical tunnel area, f_T, of Section 7.3.1 of the IPPSS. The probability distribution of f_{27A} is lognormal and has the following characteristic values:

$f_{27A,05} = 0.03$

$f_{27A,50} = 0.1$

$f_{27A,95} = 0.3$

$\alpha_{f_{27A}} = 0.12$

The fraction, f_{PF}, of motor control center fires that may occur between the two cabinets and be large enough to cause damage to both of them is assessed by comparing similar frequencies for cable spreading room fires, f_{es}; for the electrical tunnel fires, f_R; and switchgear room fires, f_{SL} of Section 7.3.1 of the IPPSS. The probability distribution of f_{PF} is lognormal and has the following characteristic values:

$f_{PF,05} = 2.0 \times 10^{-3}$

$f_{PF,50} = 2.0 \times 10^{-2}$

$f_{PF,95} = 2.0 \times 10^{-7}$

$\alpha_{f_{PF}} = 5.3 \times 10^{-2}$

The frequency of fires in fire zone 27A is computed by using probabilistic arithmetic. The resulting distribution has the following characteristic values (per reactor year):

$$\lambda_{Fire,05} = 4.9 \times 10^{-6}$$

$$\lambda_{Fire,50} = 6.9 \times 10^{-5}$$

$$\lambda_{fire,95} = 8.2 \times 10^{-4}$$

$$\alpha_{\lambda_{fire}} = 2.2 \times 10^{-4}$$

Since the PORV block valves are normally closed and are powered from these motor control centers, it is assumed that their control and motive power will be lost and, therefore, they will fail closed. It is also assumed that the CCS, AFW, EP, and SW systems will not be adversely affected by the fire. This is because CCS and SW are normally in operation; their valves would fail as they are and the pumps would not be affected by the fire. The AFW valves fail open upon loss of power and the pump controls would not be affected by the MCC failure. The electric power is very likely to continue to provide power to the switchgears. It is assumed that SI and recirculation unavailability would increase significantly. Even if they become unity, their impact on the frequency of core melt from fires in zone 27A would be insignificant because they will be dominated either by PORV unavailability (in the case of transients) or SW unavailability (in the case of a small LOCA).

B.6.5 FIRE ZONE 74A, THE ELECTRICAL PENETRATION AREA

Fire zone 74A is the electrical penetration area at Elevation 51' of the fan house. It is the far end of the electrical tunnel. The cable trays of this area are stacked in a fashion similar to the electrical tunnel. The control cables for the auxiliary feedwater pumps and their regulating valves, the power cables for the containment fan coolers, and the power and control cables for the PORVs and their associated block valves are located in this area. The conditions are similar to those of the left stack of trays in the electrical tunnel except that the power cables of the safety injection pumps are not run through this area. Therefore, the frequency of fires, λ_{Fire}, that may fail a vital set of cables is derived using results from the electrical tunnel analysis part of the IPPSS. We write

$$\lambda_{Fire} = \lambda_{AUX} f_T Q(\tau_H)$$

where

f_T = the fraction of auxiliary building fires that may occur in fire zone 74A (this is defined in Section 7.3.1.3.1 of the IPPSS for the electrical tunnel).

$Q(\tau_H)$ = the fraction of fires in fire zone 74A that are not extinguished in time to prevent vital component failures (derived in Section 7.3.1.4.2 of the IPPSS).

In Section 7.3.1.3.1 of the IPPSS, we find:

$$f_{T,05} = 8.0 \times 10^{-3}$$

$$f_{T,50} = 4.0 \times 10^{-2}$$

$$f_{T,95} = 2.0 \times 10^{-7}$$

$$\alpha_{f_T} = 6.5 \times 10^{-2}$$

In Section 7.3.1.4.2 of the IPPSS, we find

$$Q_{05}(\tau_H) = \text{smaller than } 10^{-8}$$

$$Q_{50}(\tau_H) = 7.3 \times 10^{-2}$$

$$Q_{95}(\tau_H) = 0.68$$

$$\alpha_{Q(\tau_H)} = 0.21$$

The product of these distributions yields the following characteristic values for λ''_{Fire} (per reactor year):

$$\lambda_{Fire,05} = 5.9 \times 10^{-10}$$

$$\lambda_{Fire,50} = 1.0 \times 10^{-4}$$

$$\lambda_{Fire,95} = 2.1 \times 10^{-3}$$

$$\alpha_{\lambda_{Fire}} = 4.6 \times 10^{-4}$$

B.6.6 FIRE ZONE 75A, OUTER ANNULUS OF CONTAINMENT

Fire zone 75A is the outer annulus of the containment at Elevation 46'. It contains the power and control cables for the PORVs and their block valves and the power cables of all fan cooling units. The frequency of fire, λ_{Fire}, that may occur in this area and fail the power cables to all the fan coolers and PORVs is written as

$$\lambda_{Fire} = \lambda_{CON} f_{75A}$$

where

λ_{CON} = the frequency of fires in the containment.

λ_{75A} = the fraction of containment fires that may occur in area 75A and fail the previously listed components.

The frequency of containment fires is taken from Reference B-5. A lognormal distribution is fitted to the upper and lower bounds reported in that reference to simplify the quantification process. The characteristic values of λ_{CON} are (per reactor year):

$$\lambda_{CON,05} = 6.2 \times 10^{-3}$$

$$\lambda_{CON,50} = 1.3 \times 10^{-2}$$

$$\lambda_{CON,95} = 2.8 \times 10^{-2}$$

$$\alpha_{\lambda_{CON}} = 1.5 \times 10^{-2}$$

The fraction, f_{75A}, of containment fires occurring in fire zone 75A and failing the previously listed components is assessed by comparing two similar parameters for the switchgear area, f_{SWG}, and the electrical tunnel area, f_T, of Section 7.3.1 of the IPPSS. The probability distribution of f_{75A} is lognormal and has the following characteristic values:

$$f_{75A,05} = 4.0 \times 10^{-3}$$

$$f_{75A,50} = 2.0 \times 10^{-2}$$

$$f_{75A,95} = 1.0 \times 10^{-7}$$

$$\alpha_{f_{75A}} = 3.2 \times 10^{-2}$$

The product of these two distributions yields the following characteristic values for λ_{Fire} (per reactor year):

$$\lambda_{Fire,05} = 4.3 \times 10^{-5}$$

$$\lambda_{Fire,50} = 2.9 \times 10^{-4}$$

$$\lambda_{Fire,95} = 1.5 \times 10^{-3}$$

$$\alpha_{\lambda_{Fire}} = 4.7 \times 10^{-4}$$

B.7 REFERENCES

B-1. "Indian Point Probabilistic Safety Study," Consolidated Edison Company of New York and the Power Authority of the State of New York, March 1982.

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B-3. Response to Staff Position P9 on Indian Point 2 Fire Protection Program, attached to letter from William J. Cahill, Jr., of Consolidated Edison Company of New York to Victor Stello, Jr., of NRC, September 18, 1978.

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B-5. Apostolakis, G., and M. Kazarians, "The Frequency of Fires in Light Water Reactor Compartments," paper presented at the ANS/ENS Topical Meeting on Thermal Reactor Safety, Knoxville, Tennessee, April 6-9, 1980.

TABLE B-1

CHARACTERISTIC VALUES OF THE FREQUENCIES OF RELEASE CATEGORIES AND CORE MELT DUE TO FIRE AFTER THE MODIFICATION OF INDIAN POINT 2

Release Category/ Core Melt	Probability Level	Frequency (per reactor year) After Modification
Release Category 8B	5th Percentile	1.2×10^{-6}
	Median	5.5×10^{-6}
	95th Percentile	1.6×10^{-4}
	Mean	1.8×10^{-5}
Release Category 8A	5th Percentile	8.2×10^{-8}
	Median	6.6×10^{-7}
	95th Percentile	2.1×10^{-5}
	Mean	2.6×10^{-6}
Release Category 2RW	5th Percentile	1.6×10^{-7}
	Median	1.6×10^{-6}
	95th Percentile	4.1×10^{-5}
	Mean	6.7×10^{-6}
Core Melt	5th Percentile	3.2×10^{-6}
	Median	1.3×10^{-5}
	95th Percentile	1.6×10^{-4}
	Mean	2.7×10^{-5}

TABLE B-2

IPPSS MEAN FREQUENCIES OF FIRE CONTRIBUTORS

Fire Zone	CM	SEFC	SEC	SEF	SE	TEFC	TEC	TEF	TE	8B	8A	2RW
Electrical Tunnel 1A	8.0-5	-	-	2.4-5	5.6-5	-	-	-	-	-	2.4-5	5.6-5
SWG Room 14	5.6-5	-	-	-	5.6-5	-	-	-	-	-	-	5.6-5
Electrical Tunnel 32A	5.6-5	-	-	2.4-5	3.2-5	-	-	-	-	-	2.4-5	3.2-5
Electrical Penet. 74A	1.1-5	-	2.8-8	-	9.2-11	-	1.1-5	-	8.6-10	1.1-5	-	9.5-10
CSR 11	1.9-6	-	-	-	-	1.6-6	-	-	2.9-7	1.6-6	-	2.9-7
DG Room 10	9.0-7	8.5-7	-	-	4.4-8	-	-	-	-	8.5-7	-	4.4-8
AFWS Pump Room 23	3.0-6	-	-	-	-	3.0-6	3.0-12	2.3-10	2.3-16	3.0-6	2.3-10	2.3-16
CCS Pump Room 1	3.3-7	3.1-7	2.3-8	2.3-11	1.5-10	6.1-11	6.1-17	4.6-15	4.6-21	3.3-7	2.3-11	1.5-10
CS Pump Room 2	3.3-7	-	-	3.1-7	2.3-8	-	-	6.1-11	6.1-17	-	3.1-7	2.3-8
Makeup Pump Room 2A	3.3-7	-	-	3.1-7	2.3-8	-	-	6.1-11	6.1-17	-	3.1-7	2.3-8
Control Room 15	5.7-7	-	-	-	-	4.8-7	-	-	8.9-8	4.8-7	-	8.9-8
Containment 77A	3.3-8	3.4-12	2.3-8	2.6-16	9.4-11	9.4-9	5.6-13	7.1-13	4.2-17	3.3-8	7.1-13	9.4-11
REC Pump 78A	2.4-8	4.7-10	2.4-8	3.6-14	9.4-11	9.4-10	9.4-16	7.1-14	7.1-20	2.4-8	1.1-13	9.4-11
SI Pump Room 9	8.1-8	1.0-8	5.1-8	1.0-11	3.8-10	2.0-8	2.0-14	2.0-11	2.0-17	7.0-8	3.0-11	3.8-10
Valve Room 13A	8.1-8	1.0-8	5.1-8	1.0-11	3.8-10	2.0-8	2.0-14	2.0-11	2.0-17	7.0-8	3.0-11	3.8-10
Outer Annul 75A	3.7-8	-	2.8-8	-	9.4-11	-	9.4-9	-	7.1-13	3.7-8	-	9.5-11
RCP Area 70A	3.3-8	3.4-12	2.4-8	2.6-16	1.4-10	9.4-9	9.4-15	7.1-13	7.1-19	3.3-8	7.1-13	1.4-10
MCC Area 27A	2.6-8	-	-	1.4-9	1.1-8	-	-	1.5-8	1.5-14	-	1.6-8	1.1-8
RCP Area 71A	3.3-8	3.4-12	2.4-8	2.6-16	1.4-10	9.4-9	9.4-15	7.1-13	7.1-19	3.3-8	7.1-13	1.4-10
Total	2.1-4	1.4-6	2.8-7	4.9-5	1.4-4	5.1-6	1.1-5	1.5-8	3.8-7	1.8-5	4.9-5	1.4-4

Note: Exponential notation is indicated in abbreviated form; i.e., 8.0-5 = 8 x 10^{-5}.

TABLE B-3

MEAN FREQUENCIES OF FIRE CONTRIBUTORS AFTER PROPOSED MODIFICATION

Fire Zone	CM	SEFC	SEC	SEF	SE	TEFC	TEC	TEF	TE	8B	8A	2RW	Impact of Modification
Electrical Tunnel 1A	3.7-6	--	--	1.1-6	2.5-6	--	--	9.2-9	9.0-9	--	1.1-6	2.5-6	Affected
SWG Room 14	2.6-6	--	--	--	2.5-7	--	--	--	9.0-9	--	--	2.5-6	Affected
Electrical Tunnel 32A	2.6-6	--	--	1.1-6	1.4-6	--	--	9.2-9	5.1-9	--	1.1-6	1.4-6	Affected
Electrical Penet. 74A	1.1-5	--	2.8-8	--	9.2-11	--	1.1-5	--	8.6-10	1.1-5	--	9.5-10	No Effect
CSR 11	1.9-6	--	--	--	--	1.6-6	--	--	2.9-7	1.6-6	--	2.9-7	No Effect
DG Room 10	9.0-7	8.5-7	--	--	4.4-8	--	--	--	--	8.5-7	--	4.4-8	No Effect
AFWS Pump Room 23	3.0-6	--	--	--	--	3.0-6	3.0-12	2.3-10	2.3-16	3.0-6	2.3-10	2.3-16	No Effect
CCS Pump Room 1	3.3-7	3.1-7	2.3-8	2.3-11	1.5-10	6.1-11	6.1-17	4.6-15	4.6-21	3.3-7	2.3-11	1.5-10	No Effect
CS Pump Room 2	1.5-8	--	--	1.4-8	1.1-9	--	--	6.1-11	6.1-17	--	1.4-8	1.1-9	Affected
Makeup Pump Room 2A	1.5-8	--	--	1.4-8	1.1-9	--	--	6.1-11	6.1-17	--	1.4-8	1.1-9	Affected
Control Room 15	5.7-7	--	--	--	--	4.8-7	--	--	8.9-8	4.8-7	--	8.9-8	No Effect
Containment 77A	3.3-8	3.4-12	2.3-8	2.6-16	9.4-11	9.4-9	5.6-13	7.1-13	4.2-17	3.3-8	7.1-13	9.4-11	No Effect
REC Pump 78A	2.4-8	4.7-10	2.4-8	3.6-14	9.4-11	9.4-10	9.4-16	7.1-14	7.1-20	2.4-8	1.1-13	9.4-11	No Effect
SI Pump Room 9	8.1-8	1.0-8	5.1-8	1.0-11	3.8-10	2.0-8	2.0-14	2.0-11	2.0-17	7.0-8	3.0-11	3.8-10	No Effect
Valve Room 13A	8.1-8	1.0-8	5.1-8	1.0-11	3.8-10	2.0-8	2.0-14	2.0-11	2.0-17	7.0-8	3.0-11	3.8-10	No Effect

Note: Exponential notation is indicated in abbreviated form; i.e., 8.0-5 = 8×10^{-5}.

TABLE B-3 (continued)

MEAN FREQUENCIES OF FIRE CONTRIBUTORS AFTER PROPOSED MODIFICATION

Fire Zone	CM	SEFC	SEC	SEF	SE	TEFC	TEC	TEF	TE	8B	8A	2RW	Impact of Modification
Outer Annul 75A	3.7-8	--	2.8-8	--	9.4-11	--	9.4-9	--	7.1-13	3.7-8	--	9.5-11	No Effect
RCP Area 70A	3.3-8	3.4-12	2.4-8	2.6-16	1.4-10	9.4-9	9.4-15	7.1-13	7.1-19	3.3-8	7.1-13	1.4-10	No Effect
MCC Area 27A	2.6-8	--	--	1.4-9	1.1-8	--	--	1.5-8	1.5-14	--	1.6-8	1.1-8	No Effect
RCP Area 71A	3.3-8	3.4-12	2.4-8	2.6-16	1.4-10	9.4-9	9.4-15	7.1-13	7.1-19	3.3-8	7.1-13	1.4-10	No Effect
Total	2.7-5	1.4-6	2.8-7	2.2-6	6.7-6	5.1-6	1.1-5	3.4-8	4.0-7	1.8-5	2.2-6	6.7-6	

Note: Exponential notation is indicated in abbreviated form; i.e., 8.0-5 = 8 x 10^{-5}.

TABLE B-4

FREQUENCIES OF SEVERAL PARAMETERS USED IN SECTION B.5

Parameter	Distribution	Mean	Variance	Source
Q_{SW}	Lognormal	2.46×10^{-5}	1.84×10^{-8}	Table 1.5.1-4 of IPPSS, item 29.
$Q_{CCS,D}$	Lognormal	6.41×10^{-3}	7.78×10^{-6}	Table 1.5.1-4 of IPPSS, item 11.
λ_{CCS}	Lognormal	1.68×10^{-5} per hour	2.76×10^{-8} per hour	Table 1.5.1-4 of IPPSS, item 16.
$Q_{CCS,M}$	Lognormal	5.6×10^{-5}	3.14×10^{-9}	Table 1.5.1-13 of IPPSS, approximating techniques $T_m = 1.0$, $T_{Comp} = 17832.0$.
λ_{AUX}	Gamma	0.034 per year		Section 7.3.1.3 of IPPSS.
f_T	Lognormal	6.51×10^{-2}	6.71×10^{-3}	Section 7.3.1.3 of IPPSS.
f_R	Almost Certain	0.5	--	Section 7.3.1.4.3 of IPPSS.
$Q(\tau_Y)$	See the Source	0.44		Section 7.3.1.4.2 of IPPSS.

TABLE B-5

IPPSS FIRE CONTRIBUTIONS

Fire Area	Core Melt Related Components		Containment Related Components		Point Estimates										Remarks
	Within Fire Area	Outside Fire Area	Within Fire Area	Outside Fire Area	Fire Frequency	Core Melt	SEFC	SEC	SEF	SE	TEFC	TEC	TEF	TE	
1: CCS Pump Room	CCS P (all)	CCS 1.0 (all) SIS 2.-4 AFWS 2.-5 EP 3.3-7 SWS 5.1-5 REC 5.-4 PORV 6.2-3 (from page 1.3-128 for OP1)	--	CS 7.5-5 (all) CF 1.-6	4.4-4	3.3-7	3.1-7	2.3-8	2.3-11	1.5-10	6.1-11	6.1-17	4.6-15	4.6-21	Part of CCS system. 8B = 3.3-7 8A = 2.3-11 2RW = 1.5-10 λ_{AUX} = 3.4-2 f_2 = 0.013 EP is 10 times higher than that of Table 1.5.2.2.1-2D
1A: Electrical Tunnel	SIS (all) P CCS P (all) RHR (all) P CHG P & C PORV P & C AFW Pumps C	CHG 1.0 CCS 1.0 SIS 1.0 AFWS 0.05 EP 3.3-7 SWS 5.1-4 REC 1.0 PORV 1.0	CS P (all) CF P (all)	CS 1.0 CF 1.0	See 7.3.1	8.-5	--	--	2.4-5	5.6-5	--	--	--	--	From Section 7.3.1 of the IPPSS, page 7.3-27.
2: Containment Spray Pump Room	CCS P (all)	See Fire Zone 1	CS (all)	CF 1.-6 (all) CS 1.0	4.4-4	3.3-7	--	--	3.1-7	2.3-8	--	--	6.1-11	6.1-17	8B = -- 8A = 3.1-7 2RW = 2.3-8 $\lambda_{AUX} f_2$

P = power cables; C = control cables; CHG = charging pumps; CCS = component cooling system; SIS = safety injection system; AFWS = auxiliary feedwater system; EP = electric power; SWS = service water system; REC = recirculation system; PORV = PORVs and block valves; RHR = residual heat removal; MCC = motor control center.

TABLE B-5 (continued)

IPPSS FIRE CONTRIBUTIONS

Fire Area	Core Melt Related Components		Containment Related Components		Point Estimates										Remarks
	Within Fire Area	Outside Fire Area	Within Fire Area	Outside Fire Area	Fire Frequency	Core Melt	SEFC	SEC	SEF	SE	TEFC	TEC	TEF	TE	
2A: Primary Water Makeup Pump Room	CCS P (all) CHG C (all)	CCS 1.0 SIS 2.-4 AFWS 2.-5 EP 3.-7 SW 5.-5 REC 5.-4 PORV 6.2-3	CS P (all)	CS 1.0 (all) CF 1.-6 (all)	4.4-4	3.3-7	--	--	3.1-7	2.3-8	--	--	6.1-11	6.1-17	8B = 3.1-7 8A = 3.1-7 2RW = 2.3-8 $\lambda_{AUX} f_2$
3: RHR Pump Room	RHR 22 P		--												Part of RHR system. Large LOCA not possible by fire.
3A: Corridor	RHR 21 and 22 P		--												Part of RHR system. Large LOCA not possible by fire.
4: RHR Pump Room	RHR 21 P														Part of RHR system. Large LOCA not possible by fire.
4A	--		--												
5: CHG Pump Room	CHG (all)		--												Part of CHG system analysis. CCS will prevent RCP seal LOCA.
5A	--		--												

P = power cables; C = control cables; CHG = charging pumps; CCS = component cooling system; SIS = safety injection system; AFWS = auxiliary feedwater system; EP = electric power; SWS = service water system; REC = recirculation system; PORV = PORVs and block valves; RHR = residual heat removal; MCC = motor control center.

IPPSS FIRE CONTRIBUTIONS

Fire Area	Core Melt Related Components		Containment Related Components		Point Estimates										Remarks
	Within Fire Area	Outside Fire Area	Within Fire Area	Outside Fire Area	Fire Frequency	Core Melt	SEFC	SEC	SEF	SE	TEFC	TEC	TEF	TE	
6	CHG 22,23		--												Part of CHG system.
6A	CHG (all)		--												Part of CHG system analysis.
7	CHG 23		--												
7A	Remote S/D Panel CHG C CCSHX														Very small impact on components needed for safe S/D.
8	BAT 21 and 22		--												Part of CHG system.
8A	--		--												
9: SI Pump room	SIS (all)	CCS 1.-5 SIS 1.0 AFWS 2.-5 EP 3.3-7 SWS 5.1-5 REC 5.-4 PORV 6.2-3	--	CS 1.-3 CF 1.-6	10^{-3}	8.1-8	1.-8	5.1-8	1.-11	3.8-10	2.-8	2.-14	2.-11	2.-17	Part of SI system. 8B = 8.1-8 8A = 3.0-11 2RW = 3.8-10
9A	--		--												
10: DG Building	All three diesels		--		See 7.3.1	9.-7	8.5-7	--	--	4.4-8	--	--	--	--	See Section 7.3.1 for detail.
10A	--		--												

P = power cables; C = control cables; CHG = charging pumps; CCS = component cooling system; SIS = safety injection system; AFWS = auxiliary feedwater system; EP = electric power; SWS = service water system; REC = recirculation system; PORV = PORVs and block valves; RHR = residual heat removal; MCC = motor control center.

TABLE B-5 (continued)

IPPSS FIRE CONTRIBUTIONS

Fire Area	Core Melt Related Components		Containment Related Components		Point Estimates										Remarks
	Within Fire Area	Outside Fire Area	Within Fire Area	Outside Fire Area	Fire Frequency	Core Melt	SEFC	SEC	SEF	SE	TEFC	TEC	TEF	TE	
11: CSR						1.9-6	--	--	--	--	1.6-6	--	--	2.9.-7	See Section 7.3.1 for detail
11A	--		--												
12	Batteries														
12A	--		--												
13	Batteries														
13A: Valve Room	RHR 21 and 22 P SIS(all) P	CCS 1.-5 SIS 1.0 AFWS 2.-5 EP 3.-7 SW 5.-5 REC 5.-4 PORV 6.2-3	--	CS 1.-3 CF 1.-6	10^{-3}	8.1-8	1.-8	5.1-8	1.-11	3.8-10	2.-8	2.-14	2.-11	2.-17	8B = 8.-8 8A = 3.-11 2RW = 3.8-10
14: SWG Room						5.6-5	--	--	--	5.6-5	--	--	--	--	See Section 7.3.1
14A	--		--												
15: Control Room	Controls of all Components	Power of all Components	Controls of all Components	Power of all Components	See cable spreading room (CSR) study	5.7-7	--	--	--	--	4.8-7	--	--	8.9-8	Same as CSR except for factor f_{CR} (αf_{CR} = 0.3) reduction due to human presence.

P = power cables; C = control cables; CHG = charging pumps; CCS = component cooling system; SIS = safety injection system; AFWS = auxiliary feedwater system; EP = electric power; SWS = service water system; REC = recirculation system; PORV = PORVs and block valves; RHR = residual heat removal; MCC = motor control center.

IPPSS FIRE CONTRIBUTIONS

Fire Area	Core Melt Related Components		Containment Related Components		Point Estimates										Remarks
	Within Fire Area	Outside Fire Area	Within Fire Area	Outside Fire Area	Fire Frequency	Core Melt	SEFC	SEC	SEF	SE	TEFC	TEC	TEF	TE	
15A: Valve Room	--		--												
16	--		--												
16A	--		--												
17	--		--												
17A	--		--												
18	--		--												
18A	--		--												
19	--		--												
19A	--		--												
20	--		--												
20A	--		--												
21	--		--												
21A	--		--												
22: Intake Structure	SW (all)														Part of SWS analysis. Pumps in open area.

P = power cables; C = control cables; CHG = charging pumps; CCS = component cooling system; SIS = safety injection system; AFWS = auxiliary feedwater system; EP = electric power; SWS = service water system; REC = recirculation system; PORV = PORVs and block valves; RHR = residual heat removal; MCC = motor control center.

TABLE B-5 (continued)

IPPSS FIRE CONTRIBUTIONS

Fire Area	Core Melt Related Components: Within Fire Area	Core Melt Related Components: Outside Fire Area	Containment Related Components: Within Fire Area	Containment Related Components: Outside Fire Area	Point Estimates: Fire Frequency	Core Melt	SEFC	SEC	SEF	SE	TEFC	TEC	TEF	TE	Remarks
22A	--		--												
23: AFWS Pump Room	AFWS (all)	AFWS 1.0 SIS 2.-4 REC 5.-4 PORV 6.2-3 SW 5.-5 EP 3.-7 CCS 1.-5	--	CS 7.5-5 (all) CF 1.-6	4.4-4	3.0-6	--	--	--	--	3.0-6	3.0-12	2.3-10	2.3-16	Part of AFWS analysis. 8B = 3.1-6 8A = 2.3-10 2RW = 2.3-16
23A	--		--												
24A	--		--												
25A	--		--												
26A	--		--												
27A MCC Area	MCC 26A and 26B	PORV 1.0 AFWS 7.-5 EP 3.-7 SW 5.-5 REC 0.6 SIS 0.03	CS (MOVs)	CS 1.0 CF 10^{-6} (all)	2.2-4	2.6-8	--	--	1.4-9	1.1-8	--	--	1.5-8	1.5-14	f_{27A} = .121 ≡ fraction of auxiliary building fire in MCC area. f_{DF} = .053 ≡ fraction of MCC fire disabling both MCCs. λ_{AUX} = 0.034 8B = -- 8A = 1.6-8 2RW = 1.1-8
28A	--		--												

P = power cables; C = control cables; CHG = charging pumps; CCS = component cooling system; SIS = safety injection system; AFWS = auxiliary feedwater system; EP = electric power; SWS = service water system; REC = recirculation system; PORV = PORVs and block valves; RHR = residual heat removal; MCC = motor control center.

TABLE B-5 (continued)

IPPSS FIRE CONTRIBUTIONS

Fire Area	Core Melt Related Components		Containment Related Components		Point Estimates										Remarks
	Within Fire Area	Outside Fire Area	Within Fire Area	Outside Fire Area	Fire Frequency	Core Melt	SEFC	SEC	SEF	SE	TEFC	TEC	TEF	TE	
29A	--		--												
30A	SW Pipes														Part of SW system analysis. Not susceptible to fire.
31A	--		--												
32A: Tunnel						5.6-5	--	--	2.4-5	3.2-5	--	--	--	--	See Section 7.3.1.7 of the IPPSS, p. 7.3-34
33A	--		--												
39A	--		--												
40A	--		--												
41A	--		--												
42A	--		--												
43A	--		--												
44A	--		--												
45A	--		--												
46A	--		--												
47A	--		--												

P = power cables; C = control cables; CHG = charging pumps; CCS = component cooling system; SIS = safety injection system; AFWS = auxiliary feedwater system; EP = electric power; SWS = service water system; REC = recirculation system; PORV = PORVs and block valves; RHR = residual heat removal; MCC = motor control center.

TABLE B-5 (continued)

IPPSS FIRE CONTRIBUTIONS

Fire Area	Core Melt Related Components		Containment Related Components		Point Estimates										Remarks
	Within Fire Area	Outside Fire Area	Within Fire Area	Outside Fire Area	Fire Frequency	Core Melt	SEFC	SEC	SEF	SE	TEFC	TEC	TEF	TE	
48A	--		--												
49A	--		--												
50A	--		--												
51A	--		--												
52A	--		--												
53A	--		--												
55A	--		--												
56A	--		--												
57A	--		--												
58A	--		--												
59A	Charcoal Filters														Does not pose immediate safety concern.
60A	Secondary RV P & C Penetration Cooling System														The plant can be safety shutdown without these components.
61A	--		--												

P = power cables; C = control cables; CHG = charging pumps; CCS = component cooling system; SIS = safety injection system; AFWS = auxiliary feedwater system; EP = electric power; SWS = service water system; REC = recirculation system; PORV = PORVs and block valves; RHR = residual heat removal; MCC = motor control center.

TABLE B-5 (continued)

IPPSS FIRE CONTRIBUTIONS

Fire Area	Core Melt Related Components		Containment Related Components		Point Estimates										Remarks
	Within Fire Area	Outside Fire Area	Within Fire Area	Outside Fire Area	Fire Frequency	Core Melt	SEFC	SEC	SEF	SE	TEFC	TEC	TEF	TE	
62A	Boiler Feedwater Components														Part of AFWS study.
63A	--		--												
64A	--		--												
65A	Main Feed-water Related Atmos-pheric Relief Valves														The plant can be safely shut-down without these components.
70A RCP Area	PORV P & C	PORV 1. CCS 1.-5 SIS 2.-4 AFWS 2.-5 EP 2.-7 SW 5.-5 REC 5.-4	--	CS 7.5-5 CF 1.-6	4.7-4 see 75A	3.3-8	3.4-12	2.4-8	2.6-16	1.4-10	9.4-9	9.4-15	7.1-13	7.1-19	Part of PORV failure frequency. 8B = 3.3-8 8A = 7.1-13 2RW = 1.4-10
71A	PORV P & C SIS Valves RHR Valves CHG Valves	Same as 70A		Same as 70A	4.7-4 see 75A	3.3-8	3.4-12	2.4-8	2.6-16	1.4-10	9.4-9	9.4-15	7.1-13	7.1-19	Only PORV failure affects plant safety; others are in safe position /should be quantified as part of PORV failure frequency. See 70A.

P = power cables; C = control cables; CHG = charging pumps; CCS = component cooling system; SIS = safety injection system; AFWS = auxiliary feedwater system; EP = electric power; SWS = service water system; REC = recirculation system; PORV = PORVs and block valves; RHR = residual heat removal; MCC = motor control center.

TABLE B-5 (continued)

IPPSS FIRE CONTRIBUTIONS

Fire Area	Core Melt Related Components		Containment Related Components		Point Estimates										Remarks
	Within Fire Area	Outside Fire Area	Within Fire Area	Outside Fire Area	Fire Frequency	Core Melt	SEFC	SEC	SEF	SE	TEFC	TEC	TEF	TE	
72A	RHR Valves		CF 22 P												Failure of RHR valves has little effect on plant safety; this fire zone can be regarded as part of CF system failure analysis.
74A: Electrical Penetrations Fan House	AFWS C PORV P & C Atmosphere P & C	PORV 1.0 CCS 1.-5 SIS 2.-4 AFWS 0.025 (see page 7.3-14) SWS 5.-5 EP 2.-7	CF P	CF 1.0 CS 7.5-5	4.6-4	1.1-5	--	2.8-8	--	9.2-11	--	1.1-5	--	8.6-10	8B = 1.1-5 8A = -- 2RW = 8.6-10 λ_{AUX} = 2.4-2 f_T = 6.5-2 $Q(\tau)$ = 0.21
75A: Outer Annulus Containment	PORV P & C Przr Heaters	PORV 1.0 CCS 1.-5 SIS 2.-4 AFWS 2.-5 EP 2.-7 SWS 5.-5 REC 5.-4	CF P (all)	CF 1.0 CS 7.5-5	4.7-4	3.7-8	--	2.8-8	--	9.4-11	--	9.4-9	--	7.1-13	8B = 3.7-8 8A = -- 2RW = 9.5-11 $\lambda_{containment}$ = 1.5-2 f_{75A} = 3.2-2
76A: Containment	--		CF 23, 24, 25 P	CF 1.0 CS 1.-3											Part of CF failure study; plant can be safely shut down.

P = power cables; C = control cables; CHG = charging pumps; CCS = component cooling system; SIS = safety injection system; AFWS = auxiliary feedwater system; EP = electric power; SWS = service water system; REC = recirculation system; PORV = PORVs and block valves; RHR = residual heat removal; MCC = motor control center.

IPPSS FIRE CONTRIBUTIONS

Fire Area	Core Melt Related Components: Within Fire Area	Core Melt Related Components: Outside Fire Area	Containment Related Components: Within Fire Area	Containment Related Components: Outside Fire Area	Point Estimates: Fire Frequency	Core Melt	SEFC	SEC	SEF	SE	TEFC	TEC	TEF	TE	Remarks
77A - Contain-ment	PORV P	PORV 1.0 CCS 1.-5 SIS 2.-4 AFWS 2.-5 EP 2.-7 SW 5.-5 REC 5.-4	CF 25 P	CF 6.-5 CS 7.5-5	4.7-4 see 75A	3.3-8	3.4-12	2.3-8	2.6-16	9.4-11	9.4-9	5.6-13	7.1-13	4.2-17	8B = 3.3-8 8A = 7.1-13 2RW = 9.4-11
78A - Recircu-lation Pump Area	RHRHX REC Pumps CCS Valves for RHRHX cooling	PORV 6.2-3 SIS 2.-4 REC 0.1 AFWS 2.-5 EP 2.-7 SW 5.-5 CCS 1.-5	--	CF 1.-6 CS 7.5-5	4.7-4 See 75A	2.4-8	4.7-10	2.4-8	3.6-14	9.4-11	9.4-10	9.4-16	7.1-14	7.1-20	Recirculation failure if CF is failed. 8B = 2.4-8 8A = 1.1-13 2RW = 9.4-11
80A	--		CF 21												Part of CF system analysis.
81A	--		CF 23												Part of CF system analysis.
82A	--		CF 24												Part of CF system analysis.
83A	--		CF 25												Part of CF system analysis.

P = power cables; C = control cables; CHG = charging pumps; CCS = component cooling system; SIS = safety injection system; AFWS = auxiliary feedwater system; EP = electric power; SWS = service water system; REC = recirculation system; PORV = PORVs and block valves; RHR = residual heat removal; MCC = motor control center.

IPPSS FIRE CONTRIBUTIONS

Fire Area	Core Melt Related Components		Containment Related Components		Point Estimates										Remarks
	Within Fire Area	Outside Fire Area	Within Fire Area	Outside Fire Area	Fire Frequency	Core Melt	SEFC	SEC	SEF	SE	TEFC	TEC	TEF	TE	
84A	--		CF 22												Part of CF system analysis.
85A	Incore Detector		--												Failure would not lead to severely adverse situations.
86A	Przr, SGS, CR Drives, Hydrogen Recom- biners														Fire cannot lead to mechanical component failure; therefore, this area is not critical.
87A	--		--												
90A	--		--												
91A	--		--												
94A	--		--												
95A	--		--												
96A	--		--												
97A	--		--												
98A	--		--												

P = power cables; C = control cables; CHG = charging pumps; CCS = component cooling system; SI: safety injection system; AFWS = auxiliary feedwater system; EP = electric power; SWS = service water system; REC = recirculation system; PORV = PORVs and block valves; RHR = residual heat removal; MCC = motor control center.

TABLE B-5 (Continued)

IPPSS FIRE CONTRIBUTIONS

Fire Area	Core Melt Related Components		Containment Related Components		Point Estimates										Remarks
	Within Fire Area	Outside Fire Area	Within Fire Area	Outside Fire Area	Fire Frequency	Core Melt	SEFC	SEC	SEF	SE	TEFC	TEC	TEF	TE	
99A	--		Charcoal Filters												No effect on risk.
100A	--		--												
101A	--		--												
105A	--		--												
106A	RWST		--												Part of RWST failure frequency.

P = power cables; C = control cables; CHG = charging pumps; CCS = component cooling system; SIS = safety injection system; AFWS = auxiliary feedwater system; EP = electric power; SWS = service water system; REC = recirculation system; PORV = PORVs and block valves; RHR = residual heat removal; MCC = motor control center.

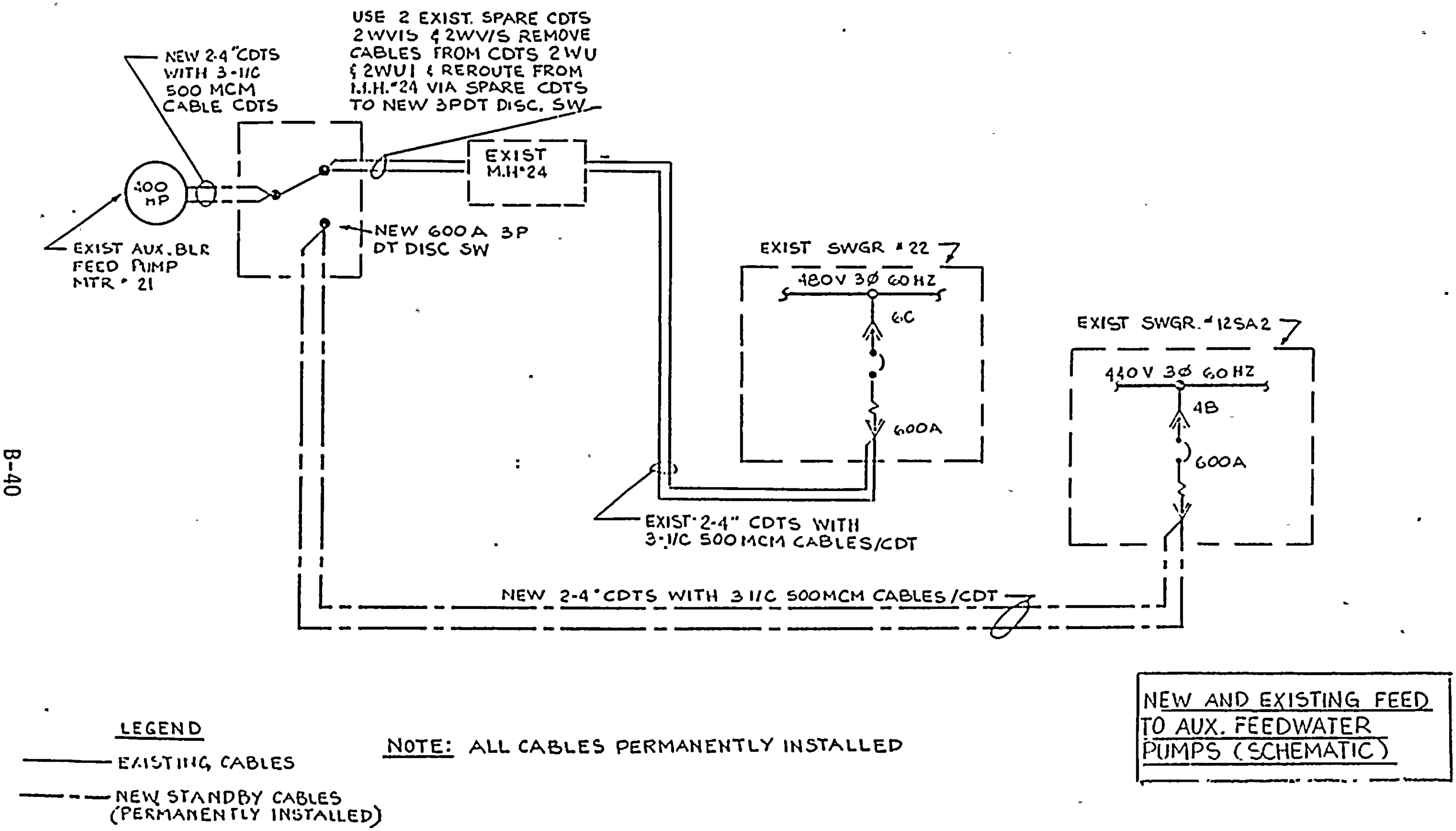

Figure B-1. Schematics of the Transfer Switch Installed for AFWS Pump 21

PUMP AND VALVE

OPERABILITY ASSURANCE REVIEW

I. PLANT INFORMATION

1. Name: PVNGS - UNIT 1 2. Docket No.: STN 50-528/529/530

3. Utility: ARIZONA PUBLIC SERVICE

4. NSSS: COMBUSTION ENGINEERING [X] PWR [ ] BWR

5. A/E: BECTHEL

II. GENERAL COMPONENT[a] INFORMATION

1. Supplier: [X] NSSS [ ] BOP

2. Location: a. Building/Room AUX. BLDG.

b. Elevation 100 Ft.

c. System CHEMICAL VOLUME CONTROL SYSTEM

3. Component number on in-house drawings: TAG NO. CHB-P01

4. If component is a [X] Pump complete II.5.

If component is a [ ] Valve complete II.6.

5. General Pump Data

	a. Pump	b. Prime-mover
Name	CHARGING PUMP	MOTOR
Mfg.	GAULIN CORPORATION	WESTING HOUSE ELECTRIC CORP
Model	NP18 -3.1 TFS	TEDP
S/N	560313-2	7707-02-003
Type	RECIPROCATING	INDUCTION, HORIZONTAL, AC

a. The component, whether pump or valve, is considered to be an assembly composed of the body, internals, prime-mover (or actuator) and functional accessories.

a. Pump (continued)

Size OVERAL INCL PUMP & MOTOR 97"L 70"W 37"H

Weight 5000 LBS

Mounting Method ANCHOR BOLTS

Required B.H.P. 100

Parameter	Design	Operating
Press	3010 PSIG	2735 PSIG
Temp	250°F	
Flow	44 GPM	
Head		

Required NPSH at maximum flow 8.2 PSIA

Available NPSH 9.0 PSIA

Operating Speed 195 RPM

Critical Speed

b. Prime-mover (continued)

Size 20" DIA 30" LONG

Weight 850 LBS

Mounting Method ANCHOR BOLTS

H.P. 100 HP

Power requirements: (include normal, maximum and minimum).

Electrical VOLTS - 460 NORMAL 345 MIN

CYCLES - 60

PHASES - 3

Other SPACE HEATERS - 120 VOLTS AC SINGLE PHASE 110 WATTS

If MOTOR list:

Duty cycle CONTINUOUS

Stall current 725

Class of insulation H

List functional accessories:* PUMP, MOTOR, BASE SUPPLIED AS A COMPLETE UNIT. MOTOR STARTING CIRCUIT REQD. TO MAKE PUMP OPERATIONAL.

List control signal inputs:

* Functional accessories are those sub-components not supplied by the manufacturer that are required to make the pump assembly operational, (e.g., coupling, lubricating oil system, etc.)

6. General Valve Data

a. Valve

Name ______________________

Mfg. ______________________

Model ______________________

S/N ______________________

Type ______________________

Size ______________________

Weight ______________________

Mounting Method ______________________

Required Torque ______________________

Parameter	Design	Operating
Press	______	______
Temp	______	______
Flow	______	______

Max ΔP across valve ______

Closing time @ max $\bar{\Delta}$P ______

Opening time @ max $\bar{\Delta}$P ______

Power requirements for functional accessories, (if any) ______

____

b. Actuator (if not an integral unit)

Name ______________________

Mfg. ______________________

Model ______________________

S/N ______________________

Type ______________________

Size ______________________

Weight ______________________

Mounting Method ______________________

Torque ______________________

Power requirements: (include normal, maximum and minimum).

Electrical ______________________

____

____

____

Other: [] Pneumatic [] Hydraulic

____

____

____

____

List control signal inputs: ______________________

____

____

List functional accessories:* ______________________

____

III. FUNCTION

1. Briefly describe components normal and safety functions: ______

INJECT BORATED WATER INTO THE REACTOR COOLANT SYSTEM DURING NORMAL OPERATION, EMERGENCY REACTOR SHUTDOWN, AND SHUTDOWN COOLING.

2. The components normal state is: [X] Operating [] Standby

3. Safety function:

a. [X] Emergency reactor shutdown

b. [] Containment heat removal

c. [] Containment isolation

d. [] Reactor heat removal

e. [] Reactor core cooling

f. [] Prevent significant release of radioactive material to environment

g. [X] Does the component function to mitigate the consequences of one or more of the following events? [X] Yes [] No
If "Yes", identify.

[X] LOCA [X] HELB [X] MSLB

[] Other ______________________

4. Safety requirements:

[X] Intermittent Operation [] During postulated event

[] Continuous Operation [X] Following postulated event

If component operation is required following an event, give approximate length of time component must remain operational.

48 HRS (e.g., hours, days, etc.)

* Functional accessories are those sub-components not supplied by the manufacturer that are required to make the valve assembly operational, (e.g., limit switches).

5. For VALVES:

does the component [] Fail open [] Fail closed [] Fail as is

Is this the fail safe position? [] Yes [] No

Is the valve used for throttling purposes? [] Yes [] No

Is the valve part of the reactor coolant pressure boundary?
[] Yes [] No

Does the valve have a specific limit for leakage? [] Yes [] No

If "Yes" give limit: ______________________

IV. QUALIFICATION

1. Reference by specific number those applicable sections of the design codes and standards applicable to the component: ________

ASME CODE SECTION III DIV 1, 1975 SUMMER ADDENDA, SECT. XI IN SERVICE INSPECTION,

ASME POWER TEST CODE PTC 7.1, DISPLACEMENT PUMPS

2. Reference those qualification standards, used as a guide to qualify the component: ASME PTC 7.1

IEEE STD NO. 323-1974, IEEE STD NO. 344-1975

3. Identify those parts of the above qualification standards deleted or modified in the qualification program.

Deleted: Modified:

4. Have acceptance criterias been established and documented in the test plan(s) for the component? [X] Yes [] No

5. What is the expected failure mode that would keep the pump or valve assembly from performing its safety function? ________

NONE

6. Are the margins* identified in the qualification documentation?
[] Yes [X] No

---

d. Margin is the difference between design basis parameters and the test parameters used for equipment qualification.

If component is a PUMP, complete IV.7.

If component is a VALVE, complete IV.8.

7. Pump operability has been demonstrated by: [] Analysis [] Test [X] Combination

Identify PUMP tests performed:

a. [X] Shell hydrostatic (ASME Section III)

b. [X] Bearing temperature evaluations

c. [X] Seismic loading

d. [X] Vibration levels

e. [X] Exploratory vibration (Fundamental freq._____)

f. [] Seal leakage @ hydro press

g. [] Aging: [] Thermal [] Mechanical

h. [X] Flow performance
Are curves provided [X] Yes [] No

i. [X] Pipe reaction end loads (nozzle loads)

j. [] Others ________________

k. [] Extreme environment: ________________
[] Humidity ________________
[] Chemical ________________
[] Radiation ________________

8. Valve operability has been demonstrated by: [] Analysis [] Test [] Combination

Identify VALVE tests performed:

a. [] Shell hydrostatic (ASME Section III)

b. [] Cold cyclic List times:
Open __________
Closed __________

c. [] Seismic loading

d. [] Hot cyclic List times:
Open __________
Closed __________

e. [] Exploratory vibration (Fundamental freq._____)

f. [] Main seat leakage

g. [] Aging: [] Thermal
[] Mechanical

h. [] Back seat leakage

i. [] Pipe reaction end loading

j. [] Disc hydrostatic

k. [] Extreme environment

[] Humidity

[] Chemical

[] Radiation

l. [] Flow interruption capability

m. [] Flow characteristics

Are curves provided?

[] Yes [] No

n. [] Others ____________________

____

____

9. As a result of any of the tests (or analysis), were any deviations from design requirements identified? [] Yes [X] No If "Yes", briefly describe any changes made in tests (or analysis) or to the component to correct the deviation.

____

____

____

10. Was the test component precisely identical (as to model, size, etc.) to the in-plant component? [X] Yes [] No If "No", is installed component [] oversized or [] undersized?

11. If type test was used to qualify the component, does the type test meet the requirements of IEEE 323-1974, Section 5.? [] Yes [] No

12. Is component orientation sensitive? [X] Yes [] No [] Unknown If "Yes", does installed orientation coincide with test orientation? [X] Yes [] No

13. Is the component mounted in the same manner in-plant as it was during testing (i.e., welded, same number and size bolts, etc.) [] Yes [X] No [] Unknown

14. Were the qualification tests performed in sequence and on only one component? [] Yes [] No N/A

If "Yes" identify sequence, (e.g., radiation, seismic, cyclic, thermal, etc.): ______

______

15. If "aging"* was performed, identify the significant aging mechanisms: ______

______

______

16. Identify loads imposed (assumed) on the component for the qualification tests (analysis) performed:

a. [] Plants (shutdown loads) b. [] Extreme environment

c. [X] Seismic load d. [X] Others NOZZLE LOADS

17. Have component design specifications been reviewed in-house to assure they envelope all expected operating, transient, and accident conditions? [X] Yes [] No

18. Does the component utilize any unique or special materials? (Examples are special gaskets or packing, limitations on nonferrous materials, or special coatings or surfaces.) [] Yes [X] No

If "Yes", identify: ______

______

19. Does component require any special maintenance procedures or practices, (including shorter periods between maintenance). [] Yes [X] No

If "Yes", identify: ______

______

20. Is the qualified life for the component less than 40 years? [] Yes [X] No If "Yes", what is the qualified life? ______

* As outlined in Section 4.4.1 of IEEE-627 1980.

21. Information Concerning Qualification Documents for the Component

Report Number	Report Title	Date	Company/Organization Preparing Report	Company/Organization Reviewing Report
81	ENGINEERING TEST REPORT	6/24/77	GAULIN CORPORATION	C-E
BS25411	SEISMIC ANALYSIS	2/18/77	WESTINGHOUSE ELECTRIC CORPORATION	C-E

PUMP AND VALVE

OPERABILITY ASSURANCE REVIEW

I. PLANT INFORMATION

1. Name: PVNGS - UNIT 1 2. Docket No.: STN 50-528/529/530
3. Utility: ARIZONA PUBLIC SERVICE
4. NSSS: COMBUSTION ENGINEERING [X] PWR [ ] BWR
5. A/E: BECTHEL

II. GENERAL COMPONENT[a] INFORMATION

1. Supplier: [X] NSSS [ ] BOP
2. Location: a. Building/Room AUX. BLD'G
   b. Elevation 40'
   c. System SAFETY INJECTION SYSTEM
3. Component number on in-house drawings: TAG NO. SIA-P01
4. If component is a [X] Pump complete II.5.
   If component is a [ ] Valve complete II.6.
5. General Pump Data

	a. Pump	b. Prime-mover
Name	LOW PRESSURE SAFETY INJECTION PUMP	PUMP MOTOR
Mfg.	INGERSOLL -RAND	WESTINGHOUSE ELECTRIC CORPORATION
Model	8X20 WDF	5010 P39 VSW2
S/N	0876-36	15-77
Type	CENTRIFUGAL PUMP VERTICAL	VERTICAL

---

a. The component, whether pump or valve, is considered to be an assembly composed of the body, internals, prime-mover (or actuator) and functional accessories.

a. Pump (continued)			b. Prime-mover (continued)
Size	91"H 50" DIA		Size 49"L 49"W 65"H
Weight	8457 LBS TOTAL ASSEMBLY		Weight 3720 LBS
Mounting Method	ANCHOR BOLTS		Mounting Method ANCHOR BOLTS
Required B.H.P.	500		H.P. 500
Parameter	Design	Operating	Power requirements: (include normal, maximum and minimum).
Press	710 PSIG		Electrical VOLTS -4000 NORMAL 3000 MIN
Temp	400°F		CYCLES -60
Flow	4200 GPM		PHASES - 3
Head	335		Other SPACE HEATERS 120 VOLTS
			PHASE - 1 WATTS - 239

Required NPSH at maximum flow 16 FT

Available NPSH 20 FT

Operating Speed 1780 RPM

Critical Speed ______

If MOTOR list:

Duty cycle CONTINUOUS

Stall current 345

Class of insulation CLASS B

List functional accessories:* PUMP, MOTOR SUPPLIED AS A COMPLETE UNIT. MOTOR STARTING CIRCUIT REQD. TO MAKE PUMP OPERATIONAL.

List control signal inputs: ______

______

______

* Functional accessories are those sub-components not supplied by the manufacturer that are required to make the pump assembly operational, (e.g., coupling, lubricating oil system, etc.)

6. General Valve Data

a. Valve

Name ______________________
Mfg. ______________________
Model ______________________
S/N ______________________
Type ______________________
Size ______________________
Weight ______________________
Mounting Method ______________________
Required Torque ______________________

Parameter	Design	Operating
Press	______	______
Temp	______	______
Flow	______	______

Max ΔP across valve ______________________

Closing time @ max ΔP ______________________

Opening time @ max ΔP ______________________

Power requirements for functional accessories, (if any) ______________________

____

b. Actuator (if not an integral unit)

Name ______________________
Mfg. ______________________
Model ______________________
S/N ______________________
Type ______________________
Size ______________________
Weight ______________________
Mounting Method ______________________
Torque ______________________

Power requirements: (include normal, maximum and minimum).

Electrical ______________________

____

____

____

Other: [] Pneumatic [] Hydraulic

____

____

____

____

List control signal inputs: ______________________

____

____

List functional accessories:* ______________________________

____

III. FUNCTION

1. Briefly describe components normal and safety functions: ________

INJECT BORATED WATER INTO THE REACTOR COOLANT SYSTEM IN EVENT OF PIPE RUPTURE. PROVIDE SHUTDOWN COOLING FLOW THROUGH REACTOR CORE AND SHUTDOWN COOLING HX'S FOR NORMAL PLANT SHUTDOWN

2. The components normal state is: [] Operating [X] Standby

3. Safety function:

a. [X] Emergency reactor shutdown
b. [] Containment heat removal
c. [] Containment isolation
d. [X] Reactor heat removal
e. [X] Reactor core cooling
f. [] Prevent significant release of radioactive material to environment
g. [X] Does the component function to mitigate the consequences of one or more of the following events? [X] Yes [] No If "Yes", identify.

[X] LOCA [] HELB [X] MSLB

[] Other ______________________________

4. Safety requirements:

[] Intermittent Operation [X] During postulated event

[X] Continuous Operation [X] Following postulated event

If component operation is required following an event, give approximate length of time component must remain operational.

120 DAYS (e.g., hours, days, etc.)

---

* Functional accessories are those sub-components not supplied by the manufacturer that are required to make the valve assembly operational, (e.g., limit switches).

5. For VALVES:

does the component [] Fail open [] Fail closed [] Fail as is

Is this the fail safe position? [] Yes [] No

Is the valve used for throttling purposes? [] Yes [] No

Is the valve part of the reactor coolant pressure boundary?
[] Yes [] No

Does the valve have a specific limit for leakage? [] Yes [] No

If "Yes" give limit: ______

IV. QUALIFICATION

1. Reference by specific number those applicable sections of the design codes and standards applicable to the component: ______

ASME CODE SECTION III , SECTION IX, WELDING QUALIFICATION

HYDRAULIC INSTITUTE FOR CENTRIFUGAL PUMPS 13Th EDITION

2. Reference those qualification standards, used as a guide to qualify the component: ______

IEEE 323 ,1974 IEEE 344 ,1975

3. Identify those parts of the above qualification standards deleted or modified in the qualification program.

Deleted: Modified:

4. Have acceptance criterias been established and documented in the test plan(s) for the component? [X] Yes [] No

5. What is the expected failure mode that would keep the pump or valve assembly from performing its safety function? ______

BEARING FAILURE

6. Are the margins* identified in the qualification documentation?
[] Yes [X] No

---

d. Margin is the difference between design basis parameters and the test parameters used for equipment qualification.

If component is a PUMP, complete IV.7.

If component is a VALVE, complete IV.8.

7. Pump operability has been demonstrated by: [] Analysis
[] Test [X] Combination

Identify PUMP tests performed:

a. [X] Shell hydrostatic (ASME Section III)
b. [] Bearing temperature evaluations
c. [] Seismic loading
d. [X] Vibration levels
e. [] Exploratory vibration (Fundamental freq._____)
f. [] Seal leakage @ hydro press
g. [] Aging: [] Thermal [] Mechanical
h. [X] Flow performance
Are curves provided [X] Yes [] No
i. [] Pipe reaction end loads (nozzle loads)
j. [] Others ________________

k. [] Extreme environment: ________________
[] Humidity ________________
[] Chemical ________________
[] Radiation ________________

8. Valve operability has been demonstrated by: [] Analysis
[] Test [] Combination

Identify VALVE tests performed:

a. [] Shell hydrostatic (ASME Section III)
b. [] Cold cyclic List times:
Open ________
Closed ________
c. [] Seismic loading
d. [] Hot cyclic List times:
Open ________
Closed ________
e. [] Exploratory vibration (Fundamental freq._____)
f. [] Main seat leakage

g. [] Aging: [] Thermal
[] Mechanical

h. [] Back seat leakage

i. [] Pipe reaction end loading

j. [] Disc hydrostatic

k. [] Extreme environment

[] Humidity

[] Chemical

[] Radiation

l. [] Flow interruption capability

m. [] Flow characteristics

Are curves provided?

[] Yes [] No

n. [] Others ____________________

9. As a result of any of the tests (or analysis), were any deviations from design requirements identified? [] Yes [X] No If "Yes", briefly describe any changes made in tests (or analysis) or to the component to correct the deviation.

10. Was the test component precisely identical (as to model, size, etc.) to the in-plant component? [X] Yes [] No If "No", is installed component [] oversized or [] undersized?

11. If <u>type</u> test was used to qualify the component, does the type test meet the requirements of IEEE 323-1974, Section 5.?
[] Yes [] No

12. Is component orientation sensitive? [X] Yes [] No [] Unknown
If "Yes", does installed orientation coincide with test orientation? [X] Yes [] No

13. Is the component mounted in the same manner in-plant as it was during testing (i.e., welded, same number and size bolts, etc.)
[] Yes [] No [X] Unknown

14. Were the qualification tests performed in sequence and on only one component? [] Yes [] No N/A

If "Yes" identify sequence, (e.g., radiation, seismic, cyclic, thermal, etc.): ______

15. If "aging"* was performed, identify the significant aging mechanisms: ______

16. Identify loads imposed (assumed) on the component for the qualification tests (analysis) performed:

a. [] Plants (shutdown loads) b. [] Extreme environment

c. [X] Seismic load d. [X] Others NOZZLE LOADS

17. Have component design specifications been reviewed in-house to assure they envelope all expected operating, transient, and accident conditions? [X] Yes [] No

18. Does the component utilize any unique or special materials? (Examples are special gaskets or packing, limitations on nonferrous materials, or special coatings or surfaces.) [] Yes [X] No

If "Yes", identify: ______

19. Does component require any special maintenance procedures or practices, (including shorter periods between maintenance), [] Yes [X] No

If "Yes", identify: ______

20. Is the qualified life for the component less than 40 years? [] Yes [X] No If "Yes", what is the qualified life? ______

* As outlined in Section 4.4.1 of IEEE-627 1980.

21. Information Concerning Qualification Documents for the Component

Report Number	Report Title	Date	Company/Organization Preparing Report	Company/Organization Reviewing Report
EAS-TR-7708-RP	STRUCTURAL INTEGRITY AND OPERABILITY ANALYSIS REV. 0	5/5/77	INGERSOL - RAND	C-E
76 F 60575	SEISMIC ANALYSIS	7/28/78	WESTINGHOUSE	C-E

PUMP AND VALVE

OPERABILITY ASSURANCE REVIEW

I. PLANT INFORMATION

1. Name: PVNGS - UNIT 1 2. Docket No.: STN 50-528/529/530
3. Utility: ARIZONA PUBLIC SERVICE
4. NSSS: COMBUSTION ENGINEERING [X] PWR [ ] BWR
5. A/E: BECTHEL

II. GENERAL COMPONENT[a] INFORMATION

1. Supplier: [X] NSSS [ ] BOP
2. Location: a. Building/Room AUXILIARY BLDG.
   b. Elevation 77 Ft.
   c. System SAFETY INJECTION/SHUTDOWN COOLING SYSTEM
3. Component number on in-house drawings: P/N 77850-2 (TAG NO. SI-655)
   (APS * SIA-UV-655)
4. If component is a [ ] Pump complete II.5.
   If component is a [X] Valve complete II.6.
5. General Pump Data

	a. Pump	b. Prime-mover
Name		
Mfg.		
Model		
S/N		
Type		

a. The component, whether pump or valve, is considered to be an assembly composed of the body, internals, prime-mover (or actuator) and functional accessories.

a. Pump (continued)			b. Prime-mover (continued)
Size ________			Size ________
Weight ________			Weight ________
Mounting Method ________			Mounting Method ________
Required B.H.P. ________			H.P. ________
<u>Parameter</u>	<u>Design</u>	<u>Operating</u>	Power requirements: (include normal, maximum and minimum).
Press	____	____	Electrical ________
Temp	____	____	________
Flow	____	____	________
Head	____	____	Other ________
			________
Required NPSH at maximum flow ________			If <u>MOTOR</u> list:
			Duty cycle ________
Available NPSH ________			Stall current ________
Operating Speed ________			Class of insulation ________
Critical Speed ________			________

List functional accessories:* ________________________

____

____

List control signal inputs: ________________________

____

____

---

* Functional accessories are those sub-components not supplied by the manufacturer that are required to make the pump assembly operational, (e.g., coupling, lubricating oil system, etc.)

6. General Valve Data

a. Valve: TAG No. SI-655	b. Actuator (if not an integral unit)
Name ISOLATION VALVE	Name MOTOR OPERATOR
Mfg. NUCLEAR VALVE DIV'N OF BORG WARNER	Mfg. LIMITORQUE
Model P/N=77850-2	Model SMB-1
S/N 27613N77850-2	S/N 264038
Type MOTOR OPERATED GATE	Type ~
Size 16 X 12 X 16 INCH	Size SMB-1-40
Weight 4900 lbs	Weight 500 lbs
Mounting Method BUTT WELD, IN PIPE LINE	Mounting Method STUDS & NUTS
Required Torque ~	Torque PER ASSY DWG.

Parameter	Design	Operating
Press (PSIG)	435	400
Temp (F)	400	350
Flow (GPM)	9000	

Max ΔP across valve 400 PSI

Closing time ~~@ max ΔP~~ 80 SEC.

Opening time ~~@ max ΔP~~ 80 SEC.

Power requirements: (include normal, maximum and minimum).

Electrical

2.6 HP NOMINAL @ 460VAC +10% -25%

36.5 AMPS MAX. @ LOCKED ROTOR

50 WATTS @ 120V FOR HEATER.

Other: [] Pneumatic [] Hydraulic

Power requirements for functional accessories, (if any) SEE ACTUATOR

List control signal inputs: HAND SWITCH, ON-OFF ONLY & INTERLOCKS:
a. RCS PRESSURE GREATER THAN 400 PSIA PREVENTS OPEN'G.
b. RCS PRESSURE GREATER THAN 500 PSIA PROVIDES AUTOMATIC CLOSURE.

List functional accessories:* LIMITORQUE SMB-1-40 MOTOR OPERATOR

III. FUNCTION

1. Briefly describe components normal and safety functions: THE VALVE IS CLOSED DURING NORMAL PLANT OPERATION & DURING OPERATION OF THE SIS, TO ISOLATE ONE SHUTDOWN COOLING SUCTION LINE. WHEN SHUTDOWN COOLING CONDITIONS ARE REACHED THE VALVE IS OPENED TO ALLOW RCS FLUID TO FLOW TO THE "SHUTDOWN COOLING"** PUMPS.

2. The components normal state is: [] Operating [X] Standby

3. Safety function:

a. [X] Emergency reactor shutdown
b. [] Containment heat removal
c. [] Containment isolation
d. [X] Reactor heat removal
e. [] Reactor core cooling
f. [] Prevent significant release of radioactive material to environment

g. [X] Does the component function to mitigate the consequences of one or more of the following events? [X] Yes [] No If "Yes", identify.

[X] LOCA [] HELB [X] MSLB

[] Other

4. Safety requirements:

[X] Intermittent Operation [] During postulated event

[] Continuous Operation [X] Following postulated event

If component operation is required following an event, give approximate length of time component must remain operational.

ONE TRAIN SDC = ≈ 1 YR (e.g., hours, days, etc.)

---

* Functional accessories are those sub-components not supplied by the manufacturer that are required to make the valve assembly operational, (e.g., limit switches).

** LPSI & CONTAINMENT SPRAY PUMPS

5. For VALVES:

does the component [] Fail open [] Fail closed [X] Fail as is

Is this the fail safe position? [X] Yes [] No

Is the valve used for throttling purposes? [] Yes [X] No

Is the valve part of the reactor coolant pressure boundary?
[] Yes [X] No

Does the valve have a specific limit for leakage? [X] Yes [] No

If "Yes" give limit: MAIN SEAT LEAKAGE < 10 CC/HR/INCH OF NOMINAL VALVE SIZE.

IV. QUALIFICATION

1. Reference by specific number those applicable sections of the design codes and standards applicable to the component:
A. ASME, B & PV, SECT. III, WINTER 1975 ADDENDA.
B. MSS-SP-61, HYDROSTATIC TESTING OF STEEL VALVES - 1961.
C. ANSI- B16.25, BUTT WELDING ENDS - 1972.

2. Reference those qualification standards, used as a guide to qualify the component: SAME AS "A" & "B" OF IV.1. ABOVE

3. Identify those parts of the above qualification standards deleted or modified in the qualification program.

Deleted: Modified:

4. Have acceptance criterias been established and documented in the test plan(s) for the component? [X] Yes [] No

5. What is the expected failure mode that would keep the pump or valve assembly from performing its safety function? NONE

6. Are the margins* identified in the qualification documentation?
[] Yes [X] No

*d. Margin is the difference between design basis parameters and the test parameters used for equipment qualification.

If component is a PUMP, complete IV.7.

If component is a VALVE, complete IV.8.

7. Pump operability has been demonstrated by: [] Analysis [] Test [] Combination

Identify PUMP tests performed:

a. [] Shell hydrostatic (ASME Section III)
b. [] Bearing temperature evaluations
c. [] Seismic loading
d. [] Vibration levels
e. [] Exploratory vibration (Fundamental freq._____)
f. [] Seal leakage @ hydro press
g. [] Aging: [] Thermal [] Mechanical
h. [] Flow performance
Are curves provided [] Yes [] No
i. [] Pipe reaction end loads (nozzle loads)
j. [] Others ________________
k. [] Extreme environment: ________________
[] Humidity ________________
[] Chemical ________________
[] Radiation ________________

8. Valve operability has been demonstrated by: [] Analysis [] Test [X] Combination

Identify VALVE tests performed:

a. [X] Shell hydrostatic (ASME Section III)
b. [X] Cold cyclic List times: Open ________ Closed ________
c. [] Seismic loading
d. [] Hot cyclic List times: Open ________ Closed ________
e. [] Exploratory vibration (Fundamental freq._____)
f. [X] Main seat leakage

g. [] Aging: [] Thermal
[] Mechanical

h. [X] Back seat leakage

i. [] Pipe reaction end loading

j. [X] Disc hydrostatic

k. [] Extreme environment
[] Humidity
[] Chemical
[] Radiation

l. [] Flow interruption capability

m. [] Flow characteristics
Are curves provided?
[] Yes [] No

n. [] Others ____________

9. As a result of any of the tests (or analysis), were any deviations from design requirements identified? [] Yes [X] No If "Yes", briefly describe any changes made in tests (or analysis) or to the component to correct the deviation.

____

____

____

10. Was the test component precisely identical (as to model, size, etc.) to the in-plant component? [X] Yes [] No If "No", is installed component [] oversized or [] undersized?

11. If type test was used to qualify the component, does the type test meet the requirements of IEEE 323-1974, Section 5.?
[] Yes [] No

12. Is component orientation sensitive? [] Yes [X] No [] Unknown
If "Yes", does installed orientation coincide with test orientation? [] Yes [] No

13. Is the component mounted in the same manner in-plant as it was during testing (i.e., welded, same number and size bolts, etc.)
[] Yes [] No [X] Unknown

14. Were the qualification tests performed in sequence and on only one component? [] Yes [] No

If "Yes" identify sequence, (e.g., radiation, seismic, cyclic, thermal, etc.): ____________________

____

15. If "aging"* was performed, identify the significant aging mechanisms: ____________________

____

____

16. Identify loads imposed (assumed) on the component for the qualification tests (analysis) performed:

a. [] Plants (shutdown loads)
b. [] Extreme environment
c. [X] Seismic load
d. [X] Others OPERATIONAL

____

17. Have component design specifications been reviewed in-house to assure they envelope all expected operating, transient, and accident conditions? [X] Yes [] No

18. Does the component utilize any unique or special materials? (Examples are special gaskets or packing, limitations on nonferrous materials, or special coatings or surfaces.) [] Yes [X] No

If "Yes", identify: ____________________

____

19. Does component require any special maintenance procedures or practices, (including shorter periods between maintenance), [] Yes [X] No

If "Yes", identify: ____________________

____

20. Is the qualified life for the component less than 40 years? [] Yes [X] No If "Yes", what is the qualified life? __________

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* As outlined in Section 4.4.1 of IEEE-627 1980.

21. Information Concerning Qualification Documents for the Component

Report Number	Report Title	Date	Company/Organization Preparing Report	Company/Organization Reviewing Report
NSR 77850-2 REV.D	SEISMIC ANALYSIS OF 16-12-16 INCH, 300 LB STAINLESS STEEL MOTOR OPERATOR GATE VALVE	27 JUNE 1978	NUCLEAR VALVE DIVISION OF BORG WARNER CORP.	COMBUSTION ENGINEERING
B0058	Limitorque	—	—	CE BAP

PUMP AND VALVE

OPERABILITY ASSURANCE REVIEW

I. PLANT INFORMATION

1. Name: PVNGS - UNIT 1 2. Docket No.: STN 50-528/529/530
3. Utility: ARIZONA PUBLIC SERVICE
4. NSSS: COMBUSTION ENGINEERING [X] PWR [] BWR
5. A/E: BECTHEL

II. GENERAL COMPONENT[a] INFORMATION

1. Supplier: [X] NSSS [] BOP
2. Location:
   a. Building/~~Room~~ Auxiliary Building/
   b. Elevation 40 Ft.
   c. System SAFETY INJECTION SYSTEM
3. Component number on in-house drawings: TAG NO: SI-404 (A.P.S. # SIA-V-404)
4. If component is a [] Pump complete II.5.
   If component is a [X] Valve complete II.6.
5. General Pump Data

	a. Pump	b. Prime-mover
Name		
Mfg.		
Model		
S/N		
Type		

---

a. The component, whether pump or valve, is considered to be an assembly composed of the body, internals, prime-mover (or actuator) and functional accessories.

a. Pump (continued)			b. Prime-mover (continued)
Size ______			Size ______
Weight ______			Weight ______
Mounting Method ______			Mounting Method ______
Required B.H.P. ______			H.P. ______
Parameter	Design	Operating	Power requirements: (include normal, maximum and minimum).
Press	______	______	Electrical ______
Temp	______	______	______
Flow	______	______	______
Head	______	______	Other ______
			______
Required NPSH at maximum flow ______			If MOTOR list: Duty cycle ______
Available NPSH ______			Stall current ______
Operating Speed ______			Class of insulation ______
Critical Speed ______			______

List functional accessories:* ______

______

______

List control signal inputs: ______

______

______

* Functional accessories are those sub-components not supplied by the manufacturer that are required to make the pump assembly operational, (e.g., coupling, lubricating oil system, etc.)

CLASS 2 , ACTIVE VALVE

CE P.O. No. 9601325

6. General Valve Data

a. Valve TAG NOS SI-404		b. Actuator (if not an integral unit)	
Name	SWING CHECK VALVE	Name	NOT APPLICABLE
Mfg.	NVD / BORG WARNER	Mfg.	
Model	79120	Model	
S/N	22630	S/N	
Type	CHECK VALVE	Type	
Size	4" 1500# S.S.	Size	
Weight	308.4 #	Weight	
Mounting Method	BUTT WELDED IN PIPE LINE	Mounting Method	
Required Torque	N/A	Torque	

Parameter	Design	Operating
Press	3600 PSIG @ 100°F	2050 PSIG
Temp	350°F	300 °F
Flow		1165 GPM
Max ΔP across valve		20.1 PSIG
Closing time @ max ΔP		N/A
Opening time @ max ΔP		N/A

Power requirements for functional accessories, (if any) N/A

Power requirements: (include normal, maximum and minimum).

Electrical NONE

Other: [] Pneumatic [] Hydraulic

NONE

List control signal inputs: NONE

List functional accessories:* NONE

III. FUNCTION

1. Briefly describe components normal and safety functions: NORMAL FUNCTION: NONE. SAFETY FUNCTIONS:
1) ISOLATES LOW PRESSURE PORTION OF SIS FROM HI PRESSURE PORTION. 2) PROVIDES BACK-UP ISOLATION OF SIS FROM RCS IN CASE OF UPSTREAM CHECK VALVE FAILURE.

2. The components normal state is: [] Operating [X] Standby

3. Safety function:

a. [] Emergency reactor shutdown

b. [] Containment heat removal

c. [] Containment isolation

d. [X] Reactor heat removal

e. [X] Reactor core cooling

f. [] Prevent significant release of radioactive material to environment

g. [X] Does the component function to mitigate the consequences of one or more of the following events? [X] Yes [] No
If "Yes", identify.

[X] LOCA [X] HELB [X] MSLB

[X] Other STEAM GENERATOR TUBE RUPTURE

4. Safety requirements:

[] Intermittent Operation [X] During postulated event

[] Continuous Operation [X] Following postulated event

If component operation is required following an event, give approximate length of time component must remain operational.

1 YEAR (e.g., hours, days, etc.)

---

* Functional accessories are those sub-components not supplied by the manufacturer that are required to make the valve assembly operational, (e.g., limit switches).

5. For VALVES:

does the component [] Fail open [] Fail closed [] Fail as is [X] N/A

Is this the fail safe position? [] Yes [] No [X] N/A

Is the valve used for throttling purposes? [] Yes [X] No

Is the valve part of the reactor coolant pressure boundary?
[] Yes [X] No

Does the valve have a specific limit for leakage? [X] Yes [] No

If "Yes" give limit: MAIN SEAT LEAKAGE 10 CC/HR/INCH OF NOM. VALVE SIZE

IV. QUALIFICATION

1. Reference by specific number those applicable sections of the design codes and standards applicable to the component:
   A. ASME B & P.V. CODE, SECT III
   B. MSS - SP-61, HYDROSTATIC TESTING OF STEEL VALVES - 1961
   C. ANSI - B16.25 BUTT WELDING ENDS - 1972

2. Reference those qualification standards, used as a guide to qualify the component: SAME AS "A" & "B" OF IV.1 ABOVE

3. Identify those parts of the above qualification standards deleted or modified in the qualification program.

   Deleted: Modified:

4. Have acceptance criterias been established and documented in the test plan(s) for the component? [X] Yes [ ] No

5. What is the expected failure mode that would keep the pump or valve assembly from performing its safety function? NONE

6. Are the margins* identified in the qualification documentation?
   [ ] Yes [X] No

d. Margin is the difference between design basis parameters and the test parameters used for equipment qualification.

If component is a PUMP, complete IV.7.

If component is a VALVE, complete IV.8.

7. Pump operability has been demonstrated by: [] Analysis
[] Test [] Combination

Identify PUMP tests performed:

a. [] Shell hydrostatic (ASME Section III)
b. [] Bearing temperature evaluations
c. [] Seismic loading
d. [] Vibration levels
e. [] Exploratory vibration (Fundamental freq._____)
f. [] Seal leakage @ hydro press
g. [] Aging: [] Thermal [] Mechanical
h. [] Flow performance
Are curves provided [] Yes [] No
i. [] Pipe reaction end loads (nozzle loads)
j. [] Others ________________________
k. [] Extreme environment: ________________________
[] Humidity ________________________
[] Chemical ________________________
[] Radiation ________________________

8. Valve operability has been demonstrated by: [ ] Analysis
[ ] Test [X] Combination

Identify VALVE tests performed:

a. [X] Shell hydrostatic (ASME Section III)
b. [] Cold cyclic List times:
Open __________
Closed __________
c. [X] Seismic loading (ANALYSIS)
d. [] Hot cyclic List times:
Open __________
Closed __________
e. [] Exploratory vibration (Fundamental freq._____)
f. [X] Main seat leakage

g. [] Aging: [] Thermal
[] Mechanical

h. [] Back seat leakage

i. [] Pipe reaction end loading

j. [] Disc hydrostatic

k. [] Extreme environment

[] Humidity

[] Chemical

[] Radiation

l. [] Flow interruption capability

m. [] Flow characteristics

Are curves provided?

[] Yes [X] No

n. [] Others ______________

9. As a result of any of the tests (or analysis), were any deviations from design requirements identified? [] Yes [X] No If "Yes", briefly describe any changes made in tests (or analysis) or to the component to correct the deviation.

10. Was the test component precisely identical (as to model, size, etc.) to the in-plant component? [X] Yes [] No If "No", is installed component [] oversized or [] undersized?

11. If type test was used to qualify the component, does the type test meet the requirements of IEEE 323-1974, Section 5.? [] Yes [] No

12. Is component orientation sensitive? [X] Yes [ ]No [] Unknown If "Yes", does installed orientation coincide with test orientation? [X] Yes [] No

13. Is the component mounted in the same manner in-plant as it was during testing (i.e., welded, same number and size bolts, etc.) [] Yes [ ]No [X] Unknown

14. Were the qualification tests performed in sequence and on only one component? [] Yes [] No

If "Yes" identify sequence, (e.g., radiation, seismic, cyclic, thermal, etc.): ____________________

____

15. If "aging"* was performed, identify the significant aging mechanisms: ____________________

____

____

16. Identify loads imposed (assumed) on the component for the qualification tests (analysis) performed:

a. [] Plants (shutdown loads) b. [] Extreme environment

c. [X] Seismic load d. [X] Others OPERATIONAL

17. Have component design specifications been reviewed in-house to assure they envelope all expected operating, transient, and accident conditions? [X] Yes [] No

18. Does the component utilize any unique or special materials? (Examples are special gaskets or packing, limitations on nonferrous materials, or special coatings or surfaces.) [] Yes [X] No

If "Yes", identify: ____________________

____

19. Does component require any special maintenance procedures or practices, (including shorter periods between maintenance), [] Yes [X] No

If "Yes", identify: ____________________

____

20. Is the qualified life for the component less than 40 years? [] Yes [X] No If "Yes", what is the qualified life? ________

* As outlined in Section 4.4.1 of IEEE-627 1980.

21. Information Concerning Qualification Documents for the Component

Report Number	Report Title	Date	Company/Organization Preparing Report	Company/Organization Reviewing Report
NSR 79120 REV A	SEISMIC ANALYSIS OF 4", 1500 LB S.S. SWING CHECK VALVES	12/7/78	NVD / BORG WARNER	COMBUSTION ENGINEERING

PUMP AND VALVE

OPERABILITY ASSURANCE REVIEW

I. PLANT INFORMATION

1. Name: PVNGS - UNIT 1 2. Docket No.: STN 50-528/529/530

3. Utility: ARIZONA PUBLIC SERVICE

4. NSSS: COMBUSTION ENGINEERING [X] PWR [ ] BWR

5. A/E: BECTHEL

II. GENERAL COMPONENT[a] INFORMATION

1. Supplier: [X] NSSS [ ] BOP

2. Location: a. Building/Room AUXILIARY BLDG.

b. Elevation 88 Ft.

c. System CHEMICAL & VOLUME CONTROL

3. Component number on in-house drawings: TAG NO. CH-505 (APS # CHB-UV-505)

4. If component is a [ ] Pump complete II.5.

If component is a [X] Valve complete II.6.

5. General Pump Data

a. Pump b. Prime-mover

	a. Pump	b. Prime-mover
Name		
Mfg.		
Model		
S/N		
Type		

---

a. The component, whether pump or valve, is considered to be an assembly composed of the body, internals, prime-mover (or actuator) and functional accessories.

a. Pump (continued)			b. Prime-mover (continued)
Size ______			Size ______
Weight ______			Weight ______
Mounting Method ______			Mounting Method ______
Required B.H.P. ______			H.P. ______
Parameter	Design	Operating	Power requirements: (include normal, maximum and minimum).
Press	______	______	Electrical ______
Temp	______	______	______
Flow	______	______	______
Head	______	______	Other ______
			______
Required NPSH at maximum flow ______			If MOTOR list:
			Duty cycle ______
Available NPSH ______			Stall current ______
Operating Speed ______			Class of insulation ______
Critical Speed ______			______

List functional accessories:* ______

______

______

List control signal inputs: ______

______

______

---

* Functional accessories are those sub-components not supplied by the manufacturer that are required to make the pump assembly operational, (e.g., coupling, lubricating oil system, etc.)

6. General Valve Data

a. Valve TAG# CH-505
DWG No. 54A6462

Name PNEUMATIC OPER VALVE
Mfg. FISHER CONTROLS
Model 667DBQ, SIZE 50 ACT.
S/N 6548710
Type DIAPGM OP. GLOBE
Size 1" VALVE, 3/4" PORTS
Weight 250 ± 25 LBS
Mounting Method BUTT WELDED IN PIPE LINE
Required Torque 10 MIN., 15 ft LBS MAX. FOR PACKING GLAND NUTS

b. Actuator (if not an integral unit)

Name ____
Mfg. ____
Model ____
S/N ____
Type ____
Size ____
Weight ____
Mounting Method ____
Torque ____

Parameter	Design	Operating
Press	2485 PSIG	100 PSIG
Temp	650°F	180°F
Flow	____	22.0 GPM

Power requirements: (include normal, maximum and minimum).

Electrical 105 VDC MINIMUM TO 140 VDC MAX SUPPLY TO ASCO VALVE

Max ΔP across valve 2485 PSID @ 0 FLOW, 6 PSIG @ FULL FLOW

Closing time ~~@ max ΔP~~ 5 SEC
Opening time ~~@ max ΔP~~ 5 SEC
Power requirements for functional accessories, (if any) ____

Other: [X] Pneumatic [] Hydraulic
80 PSIG MINIMUM TO 125 PSIG MAXIMUM AIR SUPPLY TO FILTER REGULATOR AND BOOSTER RELAY.

List control signal inputs: ____

List functional accessories:* ASCO SOLENOID VALVE (NP8320A-187V) NAMCO LIMIT SWITCHES (EA170-31302)

III. FUNCTION

1. Briefly describe components normal and safety functions: NORMAL FUNCTION: VALVE IS IN OPEN POSITION AND ALLOWS RCP SEAL CONTROLLED BLEED-OFF FLOW. EMERGENCY FUNCTION: VALVE CLOSES AND ISOLATES RADIOACTIVITY RELEASE TO OUTSIDE CONTAINMENT.

2. The components normal state is: [X] Operating [] Standby

3. Safety function:

a. [] Emergency reactor shutdown
b. [] Containment heat removal
c. [X] Containment isolation
d. [] Reactor heat removal
e. [] Reactor core cooling
f. [X] Prevent significant release of radioactive material to environment
g. [X] Does the component function to mitigate the consequences of one or more of the following events? [X] Yes [] No If "Yes", identify.

[X] LOCA [X] HELB [X] MSLB

[X] Other PREVENTS RADIOACTIVITY RELEASE OUTSIDE THE CONTAINMENT.

4. Safety requirements:

[] Intermittent Operation [X] During postulated event

[X] Continuous Operation [X] Following postulated event

If component operation is required following an event, give approximate length of time component must remain operational.

36-HRS OPERATION & MAINTAIN INTEGRITY FOR 120 DAYS POST DBE.
(e.g., hours, days, etc.)

---

* Functional accessories are those sub-components not supplied by the manufacturer that are required to make the valve assembly operational, (e.g., limit switches).

5. For VALVES:

does the component [] Fail open [X] Fail closed [] Fail as is

Is this the fail safe position? [X] Yes [] No

Is the valve used for throttling purposes? [] Yes [X] No

Is the valve part of the reactor coolant pressure boundary?
[X] Yes [] No

Does the valve have a specific limit for leakage? [X] Yes [] No

If "Yes" give limit: 10 CC/HR/INCH OF NOM. VALVE SIZE (MAIN SEAT)

IV. QUALIFICATION

1. Reference by specific number those applicable sections of the design codes and standards applicable to the component:

   A. ASME SECTION III DIV 1, SUMMER 1975 ADDENDA
   B. MSS-SP-61, HYDROSTATIC TESTING OF VALVES 1961
   C. ANSI - B16.25, BUTT WELDING ENDS - 1972

2. Reference those qualification standards, used as a guide to qualify the component: SAME AS "A" & "B" OF IV. 1, ABOVE

3. Identify those parts of the above qualification standards deleted or modified in the qualification program.

   Deleted: Modified:

4. Have acceptance criterias been established and documented in the test plan(s) for the component? [X] Yes [] No

5. What is the expected failure mode that would keep the pump or valve assembly from performing its safety function? NONE

6. Are the margins* identified in the qualification documentation?
   [] Yes [X] No

---

d. Margin is the difference between design basis parameters and the test parameters used for equipment qualification.

If component is a PUMP, complete IV.7.

If component is a VALVE, complete IV.8.

7. Pump operability has been demonstrated by: [] Analysis
[] Test [] Combination

Identify PUMP tests performed:

a. [] Shell hydrostatic (ASME Section III)
b. [] Bearing temperature evaluations
c. [] Seismic loading
d. [] Vibration levels
e. [] Exploratory vibration (Fundamental freq._____)
f. [] Seal leakage @ hydro press
g. [] Aging: [] Thermal [] Mechanical
h. [] Flow performance Are curves provided [] Yes [] No
i. [] Pipe reaction end loads (nozzle loads)
j. [] Others __________
k. [] Extreme environment: __________
[] Humidity __________
[] Chemical __________
[] Radiation __________

8. Valve operability has been demonstrated by: [ ] Analysis
[ ] Test [X] Combination

Identify VALVE tests performed:

a. [X] Shell hydrostatic (ASME Section III)
b. [X] Cold cyclic List times: Open ________ Closed ________
c. Seismic loading
d. [] Hot cyclic List times: Open ________ Closed ________
e. [] Exploratory vibration (Fundamental freq._____)
f. [X] Main seat leakage

g. [ ] Aging: [ ] Thermal
[ ] Mechanical

h. [] Back seat leakage

i. [ ] Pipe reaction end loading

j. [X] ~~Disc~~ PLUG hydrostatic

k. [ ] Extreme environment
[ ] Humidity
[] Chemical
[ ] Radiation

l. [] Flow interruption capability

m. [ ] Flow characteristics
Are curves provided?
[] Yes [ ] No

n. [ ] Others ____________________

9. As a result of any of the tests (or analysis), were any deviations from design requirements identified? Yes [] No
If "Yes", briefly describe any changes made in tests (or analysis) or to the component to correct the deviation.

____

____

____

10. Was the test component precisely identical (as to model, size, etc.) to the in-plant component? [X] Yes [] No If "No", is installed component [] oversized or [] undersized?

11. If <u>type</u> test was used to qualify the component, does the type test meet the requirements of IEEE 323-1974, Section 5.?
[ ] Yes [] No

12. Is component orientation sensitive? [] Yes [X] No [] Unknown
If "Yes", does installed orientation coincide with test orientation? [] Yes [] No

13. Is the component mounted in the same manner in-plant as it was during testing (i.e., welded, same number and size bolts, etc.)
[] Yes [ ] No [X] Unknown

14. Were the qualification tests performed in sequence and on only one component? Yes [] No

If "Yes" identify sequence, (e.g., radiation, seismic, cyclic, thermal, etc.): ______

______

15. If "aging"* was performed, identify the significant aging mechanisms: ______

______

______

16. Identify loads imposed (assumed) on the component for the qualification tests (analysis) performed:

a. [] Plants (shutdown loads) b. [] Extreme environment

c. [X] Seismic loads d. [X] Others 1. VALVE DESIGN PRESSURE

______

17. Have component design specifications been reviewed in-house to assure they envelope all expected operating, transient, and accident conditions? [X] Yes [] No

18. Does the component utilize any unique or special materials? (Examples are special gaskets or packing, limitations on nonferrous materials, or special coatings or surfaces.) [] Yes [X] No

If "Yes", identify: ______

______

19. Does component require any special maintenance procedures or practices, (including shorter periods between maintenance). [] Yes [X] No

If "Yes", identify: ______

______

20. Is the qualified life for the component less than 40 years? [] Yes [X] No If "Yes", what is the qualified life? ______

* As outlined in Section 4.4.1 of IEEE-627 1980.

21. Information Concerning Qualification Documents for the Component

Report Number	Report Title	Date	Company/Organization Preparing Report	Company/Organization Reviewing Report
1-67701 -C,	SEISMIC CERTIFICATION (INCLUDING DESIGN ANALYSIS REPORTS)	5/4/78	FISHER CONTROLS CO.	COMBUSTION ENGINEERING
FQP-8-1 REV A	FISHER QUALIFICATION SUMMARY RPT.	12/78	FISHER CONTROLS CO.	COMBUSTION ENGINEERING

PUMP AND VALVE

OPERABILITY ASSURANCE REVIEW

I. PLANT INFORMATION

1. Name: PVNGS - UNIT 1 2. Docket No.: STN 50-528/529/530
3. Utility: ARIZONA PUBLIC SERVICE
4. NSSS: COMBUSTION ENGINEERING [X] PWR [] BWR
5. A/E: BECTHEL

II. GENERAL COMPONENT[a] INFORMATION

1. Supplier: [X] NSSS [] BOP
2. Location: a. Building/Room AUXILIARY BLDG.
   b. Elevation 88 Ft.
   c. System SAFETY INJECTION SYSTEM
3. Component number on in-house drawings: P/N 77620-2 (TAG No. SI-626) (A.P.S. # SIB-UV-626)
4. If component is a [] Pump complete II.5.
   If component is a [X] Valve complete II.6.
5. General Pump Data

	a. Pump	b. Prime-mover
Name		
Mfg.		
Model		
S/N		
Type		

a. The component, whether pump or valve, is considered to be an assembly composed of the body, internals, prime-mover (or actuator) and functional accessories.

a. Pump (continued)

Size ______

Weight ______

Mounting Method ______

Required B.H.P. ______

Parameter	Design	Operating
Press	____	____
Temp	____	____
Flow	____	____
Head	____	____

Required NPSH at maximum flow ______

Available NPSH ______

Operating Speed ______

Critical Speed ______

b. Prime-mover (continued)

Size ______

Weight ______

Mounting Method ______

H.P. ______

Power requirements: (include normal, maximum and minimum).

Electrical ______

______

______

Other ______

______

If MOTOR list:

Duty cycle ______

Stall current ______

Class of insulation ______

______

List functional accessories:* ______

______

______

List control signal inputs: ______

______

______

* Functional accessories are those sub-components not supplied by the manufacturer that are required to make the pump assembly operational, (e.g., coupling, lubricating oil system, etc.)

6. General Valve Data

a. Valve: TAG No. SI-626

Name	HPSI HEADER VALVE
Mfg.	NUCLEAR VALVE DIV'N OF BORG WARNER
Model	P/N = 77620-2
S/N	26963
Type	MOTOR OPERATED GLOBE
Size	2 INCH
Weight	45 lbs
Mounting Method	BUTT WELD, IN PIPE LINE
Required Torque	~

Parameter	Design	Operating
Press (PSIG)	2485	2050
Temp (F)	350	300
Flow (GPM)	283	

Max ΔP across valve 2050

Closing time ~~@ max ΔP~~ 10 SEC.

Opening time ~~@ max ΔP~~ 10 SEC.

Power requirements for functional accessories, (if any) SEE ACTUATOR

b. Actuator (if not an integral unit)

Name	MOTOR OPERATOR
Mfg.	LIMITORQUE
Model	SMC-04
S/N	D002053
Type	~
Size	SMC-04-7½
Weight	55 lbs
Mounting Method	CAP SCREWS
Torque	PER ASSY DWG.

Power requirements: (include normal, maximum and minimum).

Electrical

0.48 HP NOMINAL @ 460 VAC +10% −25%

7.5 AMPS MAX. @ LOCKED ROTOR

20 WATTS @ 120V FOR HEATER

Other: [] Pneumatic [] Hydraulic

List control signal inputs: SIAS OPENS & HAND SWITCH, ON-OFF.

List functional accessories:* LIMITORQUE SMC-04-7½ MOTOR OPERATOR

III. FUNCTION

1. Briefly describe components normal and safety functions: THE VALVE IS CLOSED DURING NORMAL PLANT OPERATIONS. THE VALVE OPENS WHEN A SAFETY INJECTION ACTUATION SIGNAL (SIAS) OCCURS TO ALLOW HIGH PRESSURE SAFETY INJECTION PUMPED FLUID INTO THE RCS COLD LEG FROM THE RWT UNTIL RAS & THEN FROM THE CONTAINMENT SUMP.

2. The components normal state is: [] Operating [X] Standby

3. Safety function:

a. [X] Emergency reactor shutdown
b. [] Containment heat removal
c. [] Containment isolation
d. [] Reactor heat removal
e. [X] Reactor core cooling
f. [] Prevent significant release of radioactive material to environment
g. [X] Does the component function to mitigate the consequences of one or more of the following events? [X] Yes [] No If "Yes", identify.

[X] LOCA [] HELB [X] MSLB

[] Other ______

4. Safety requirements:

[X] Intermittent Operation [X] During postulated event

[] Continuous Operation [X] Following postulated event

If component operation is required following an event, give approximate length of time component must remain operational.

RECIRC. FROM CONTAINMENT SUMP FOR ≈ 1 YR. (e.g., hours, days, etc.)

* Functional accessories are those sub-components not supplied by the manufacturer that are required to make the valve assembly operational, (e.g., limit switches).

5. For VALVES:

does the component [] Fail open [] Fail closed [X] Fail as is

Is this the fail safe position? [X] Yes [] No

Is the valve used for throttling purposes? [X] Yes [] No

Is the valve part of the reactor coolant pressure boundary?
[X] Yes [] No

Does the valve have a specific limit for leakage? [X] Yes [] No

If "Yes" give limit: MAIN SEAT LEAKAGE < 10 CC/HR/INCH OF NOMINAL VALVE SIZE.

IV. QUALIFICATION

1. Reference by specific number those applicable sections of the design codes and standards applicable to the component:
A. ASME, B&PV, SECT. III, WINTER 1975 ADDENDA.
B. MSS-SP-61, HYDROSTATIC TESTING OF STEEL VALVES - 1961.
C. ANSI - B16.25, BUTT WELDING ENDS - 1972.

2. Reference those qualification standards, used as a guide to qualify the component: SAME AS "A" & "B" OF IV. 1. ABOVE.

3. Identify those parts of the above qualification standards deleted or modified in the qualification program.

Deleted: Modified:

4. Have acceptance criterias been established and documented in the test plan(s) for the component? [X] Yes [] No

5. What is the expected failure mode that would keep the pump or valve assembly from performing its safety function? NONE

6. Are the margins* identified in the qualification documentation?
[] Yes [X] No

d. Margin is the difference between design basis parameters and the test parameters used for equipment qualification.

If component is a PUMP, complete IV.7.

If component is a VALVE, complete IV.8.

7. Pump operability has been demonstrated by: [] Analysis [] Test [] Combination

Identify PUMP tests performed:

a. [] Shell hydrostatic (ASME Section III)
b. [] Bearing temperature evaluations
c. [] Seismic loading
d. [] Vibration levels
e. [] Exploratory vibration (Fundamental freq._____)
f. [] Seal leakage @ hydro press
g. [] Aging: [] Thermal [] Mechanical
h. [] Flow performance Are curves provided [] Yes [] No
i. [] Pipe reaction end loads (nozzle loads)
j. [] Others ____________________
k. [] Extreme environment: ____________________
   [] Humidity ____________________
   [] Chemical ____________________
   [] Radiation ____________________

8. Valve operability has been demonstrated by: [] Analysis [] Test [X] Combination

Identify VALVE tests performed:

a. [X] Shell hydrostatic (ASME Section III)
b. [X] Cold cyclic List times: Open ________ Closed ________
c. [] Seismic loading
d. [] Hot cyclic List times: Open ________ Closed ________
e. [] Exploratory vibration (Fundamental freq._____)
f. [X] Main seat leakage

g. [] Aging: [] Thermal
[] Mechanical

h. [X] Back seat leakage

i. [] Pipe reaction end loading

j. [X] Disc hydrostatic

k. [] Extreme environment
[] Humidity
[] Chemical
[] Radiation

l. [] Flow interruption capability

m. [] Flow characteristics
Are curves provided?
[] Yes [] No

n. [] Others ______________

9. As a result of any of the tests (or analysis), were any deviations from design requirements identified? [] Yes [X] No
If "Yes", briefly describe any changes made in tests (or analysis) or to the component to correct the deviation.

10. Was the test component precisely identical (as to model, size, etc.) to the in-plant component? [X] Yes [] No If "No", is installed component [] oversized or [] undersized?

11. If type test was used to qualify the component, does the type test meet the requirements of IEEE 323-1974, Section 5.?
[] Yes [] No

12. Is component orientation sensitive? [] Yes [X] No [] Unknown
If "Yes", does installed orientation coincide with test orientation? [] Yes [] No

13. Is the component mounted in the same manner in-plant as it was during testing (i.e., welded, same number and size bolts, etc.)
[] Yes [] No [X] Unknown

14. Were the qualification tests performed in sequence and on only one component? [] Yes [] No

    If "Yes" identify sequence, (e.g., radiation, seismic, cyclic, thermal, etc.): ______

15. If "aging"* was performed, identify the significant aging mechanisms: ______

16. Identify loads imposed (assumed) on the component for the qualification tests (analysis) performed:

    a. [] Plants (shutdown loads) b. [] Extreme environment

    c. [X] Seismic load d. [X] Others OPERATIONAL

17. Have component design specifications been reviewed in-house to assure they envelope all expected operating, transient, and accident conditions? [X] Yes [] No

18. Does the component utilize any unique or special materials? (Examples are special gaskets or packing, limitations on nonferrous materials, or special coatings or surfaces.)
    [] Yes [X] No

    If "Yes", identify: ______

19. Does component require any special maintenance procedures or practices, (including shorter periods between maintenance),
    [] Yes [X] No

    If "Yes", identify: ______

20. Is the qualified life for the component less than 40 years?
    [] Yes [X] No If "Yes", what is the qualified life? ______

* As outlined in Section 4.4.1 of IEEE-627 1980.

21. Information Concerning Qualification Documents for the Component

Report Number	Report Title	Date	Company/Organization Preparing Report	Company/Organization Reviewing Report
NSR 77620-2 Rev. A	SEISMIC ANALYSIS OF 2 INCH, 1500 LB STAINLESS STEEL MOTOR OPERATED GLOBE VALVE	5 APRIL 1979	NUCLEAR VALVE DIVISION OF BORG WARNER CORP.	COMBUSTION ENGINEERING/APS

PUMP AND VALVE

OPERABILITY ASSURANCE REVIEW

I. PLANT INFORMATION

1. Name: PALO VERDE Unit No. 1 2. Docket No.: STN 50-528/529/530

3. Utility: ARIZONA PUBLIC SERVICE

4. NSSS: COMBUSTION ENGINEEING [X] PWR [] BWR

5. A/E: BECHTEL

II. GENERAL COMPONENT* INFORMATION

1. Supplier: [] NSSS [X] BOP

2. Location: a. Building/Room AUXILIARY BLDG.

b. Elevation 88 FT.

c. System NUCLEAR COOLING WATER

3. Component number on in-house drawings: 1JNCB-UV-401

4. If component is a [] Pump complete II.5.

If component is a [X] Valve complete II.6.

5. General Pump Data

a. Pump		b. Prime-mover	
Name		Name	
Mfg.		Mfg.	
Model		Model	
S/N		S/N	
Type		Type	

* The component, whether pump or valve, is considered to be an assembly composed of the body, internals, prime-mover (or actuator) and functional accessories.

a. Pump (continued)			b. Prime-mover (continued)
Size ____			Size ____
Weight ____			Weight ____
Mounting Method ____			Mounting Method ____
Required B.H.P. ____			H.P. ____
Parameter	Design	Operating	Power requirements: (include normal, maximum and minimum).
Press	____	____	Electrical ____
Temp	____	____	____
Flow	____	____	____
Head	____	____	Other ____
			____
Required NPSH at maximum flow ____			If MOTOR list:
			Duty cycle ____
Available NPSH ____			Stall current ____
Operating Speed ____			Class of insulation ____
Critical Speed ____			____

List functional accessories:* ____

____

____

List control signal inputs: ____

____

____

---

* Functional accessories are those sub-components not supplied by the manufacturer that are required to make the pump assembly operational, (e.g., coupling, lubricating oil system, etc.)

6. General Valve Data

a. Valve

Name	Nuclear Cooling Water Supply-Containment Isol Vlv
Mfg.	Henry Pratt
Model	NXL/1100
S/N	D-0116-1-1
Type	Butterfly
Size	10 inch
Weight	233 lbs
Mounting Method.	Flanged: One end Welded other end
Required Torque	1835 in-lbs

Parameter	Design	Operating
Press(PSIG)	150	75
Temp (°F)	200	120
Flow(GPM)	NA	1988

Max ΔP across valve 75 PSI

Closing time @ max ΔP 10 Sec

Opening time @ max ΔP 10 Sec.

Power requirements for functional accessories, (if any) 480 V, 3 ɸ supply

b. Actuator (if not an integral unit)

Name	Limitorque
Mfg.	Limitorque
Model	SMB 0002-H1BC
S/N	291114
Type	AC Motor + Gear
Size	0.26 HP
Weight	257 lbs.
Mounting Method	Bolted
Torque	Capacity: 15,600 in-lbs

Power requirements: (include normal, maximum and minimum).

Electrical 480 VAC. 60Hz

	Normal	Max	Min
Voltage	460	506	345
Amps	0.55	5	0.55
HP	0.26	—	0.26

Other: [] Pneumatic [] Hydraulic

List control signal inputs: CIAS

List functional accessories:* SET OF LIMIT SWITCHES WITH LIMITORQUE OPERATOR

III. FUNCTION

1. Briefly describe components normal and safety functions: This component has no normal function. safety function is to close on CIAS.

2. The components normal state is: [] Operating [X] Standby

3. Safety function:

a. [] Emergency reactor shutdown

b. [] Containment heat removal

c. [X] Containment isolation

d. [] Reactor heat removal

e. [] Reactor core cooling

f. [] Prevent significant release of radioactive material to environment

g. [] Does the component function to mitigate the consequences of one or more of the following events? [X] Yes [] No If "Yes", identify.

[X] LOCA [] HELB [] MSLS

[] Other ______

4. Safety requirements:

[X] Intermittent Operation [X] During postulated event

[] Continuous Operation [X] Following postulated event

If component operation is required following an event, give approximate length of time component must remain operational.

30 DAYS - REMAINS CLOSED AFTER DBA (e.g., hours, days, etc.)

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* Functional accessories are those sub-components not supplied by the manufacturer that are required to make the valve assembly operational, (e.g., limit switches).

5. For VALVES:

does the component [] Fail open [] Fail closed [X] Fail as is

Is this the fail safe position? [] Yes [X] No

Is the valve used for throttling purposes? [] Yes [X] No

Is the valve part of the reactor coolant pressure boundary?
[] Yes [X] No

Does the valve have a specific limit for leakage? [X] Yes [] No

If "Yes" give limit: TESTS WERE ZERO LEAKAGE BUBBLE TIGHT.

IV. QUALIFICATION

1. Reference by specific number those applicable sections of the design codes and standards applicable to the component: ASME SECT. II, III, V, IX; ANSI B16.5, B16.11, N45.2.2, N101.2, N101.4, NEMA ICS, AWWA-C-504

2. Reference those qualification standards, used as a guide to qualify the component: IEEE-323-1974; IEEE-382-1972 IEEE-344-1975

3. Identify those parts of the above qualification standards deleted or modified in the qualification program.

Deleted: Modified:

4. Have acceptance criterias been established and documented in the test plan(s) for the component? [X] Yes [] No

5. What is the expected failure mode that would keep the pump or valve assembly from performing its safety function? LOSS OF POWER SUPPLY

6. Are the margins* identified in the qualification documentation?
[X] Yes [] No

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d. Margin is the difference between design basis parameters and the test parameters used for equipment qualification.

If component is a PUMP, complete IV.7.

If component is a VALVE, complete IV.8.

7. Pump operability has been demonstrated by: [] Analysis
[] Test [] Combination

Identify PUMP tests performed:

a. [] Shell hydrostatic (ASME Section III)
b. [] Bearing temperature evaluations
c. [] Seismic loading
d. [] Vibration levels
e. [] Exploratory vibration (Fundamental freq._____)
f. [] Seal leakage @ hydro press
g. [] Aging: [] Thermal [] Mechanical
h. [] Flow performance
Are curves provided [] Yes [] No
i. [] Pipe reaction end loads (nozzle loads)
j. [] Others ____________
k. [] Extreme environment:
[] Humidity ____________
[] Chemical ____________
[] Radiation ____________

8. Valve operability has been demonstrated by: [] Analysis
[] Test [X] Combination

Identify VALVE tests performed:

a. [X] Shell hydrostatic (ASME Section III)
b. [X] Cold cyclic List times:
Open 3
Closed 3
} For qualified Test valve assembly
c. [X] Seismic loading
d. [] Hot cyclic List times:
Open ______
Closed ______
e. [X] Exploratory vibration (Fundamental freq >33Hz)
f. [X] Main seat leakage

g. [X] Aging: [X] Thermal
[X] Mechanical

h. [] Back seat leakage

i. [] Pipe reaction end loading

j. [X] Disc hydrostatic

k. [X] Extreme environment

[X] Humidity

[X] Chemical

[X] Radiation

l. [X] Flow interruption capability

m. [] Flow characteristics

Are curves provided?

[] Yes [] No not applicable open: closed service

n. [] Others ______________

____

____

9. As a result of any of the tests (or analysis), were any deviations from design requirements identified? [] Yes [X] No If "Yes", briefly describe any changes made in tests (or analysis) or to the component to correct the deviation.

____

____

____

10. Was the test component precisely identical (as to model, size, etc.) to the in-plant component? [] Yes [X] No If "No", is installed component [] oversized or [X] undersized?

11. If type test was used to qualify the component, does the type test meet the requirements of IEEE 323-1974, Section 5.?
[] Yes [X] No

12. Is component orientation sensitive? [] Yes [X] No [] Unknown If "Yes", does installed orientation coincide with test orientation? [] Yes [] No

13. Is the component mounted in the same manner in-plant as it was during testing (i.e., welded, same number and size bolts, etc.)
[] Yes [X] No [] Unknown

14. Were the qualification tests performed in sequence and on <u>only</u> one component? [] Yes [X] No For actuator

If "Yes" identify sequence, (e.g., radiation, seismic, cyclic, thermal, etc.): Radiation exposure followed aging and seismic qualification (actuator).

15. If "aging"* was performed, identify the significant aging mechanisms: Thermal; Radiation

16. Identify loads imposed (assumed) on the component for the qualification tests (analysis) performed:

a. [] Plants (shutdown loads) b. [] Extreme environment

c. [X] Seismic load d. [] Others

17. Have component design specifications been reviewed in-house to assure they envelope all expected operating, transient, and accident conditions? [X] Yes [] No

18. Does the component utilize any unique or special materials? (Examples are special gaskets or packing, limitations on nonferrous materials, or special coatings or surfaces.)
[X] Yes [] No

If "Yes", identify: SEATING MATERIAL IS EPT

19. Does component require any special maintenance procedures or practices, (including shorter periods between maintenance).
[X] Yes [] No

If "Yes", identify: EPOXY MATERIAL (EPT) WILL BE INJECTED.

20. Is the qualified life for the component less than 40 years?
[] Yes [] No If "Yes", what is the qualified life?
DEPENDS ON LIFE OF NON-METALLIC PARTS WHICH DEPENDS ON AGING ANAYSIS IN PROGRESS

* As outlined in Section 4.4.1 of IEEE-627 1980.

21. Information Concerning Qualification Documents for the Component

Report Number	Report Title	Date	Company/Organization Preparing Report	Company/Organization Reviewing Report
JM-605-106	SEISMIC REPORT FOR 10" 1100 VALVE WITH SMB 0002-H1BC OPERATOR	AUG. 1978	H. PRATT CO.	BECHTEL
JM-605-143	FUNCTIONAL QUAL. REPORT FOR POWER OPERATED ACTIVE VALVES	JAN 1979	H. PRATT CO.	BECHTEL
JM-221B-349	LIMITORQUE REPORT B0058	NOV. 1980	LIMITORQUE	BECHTEL

1-J-SGE-UV-180

PUMP AND VALVE
OPERABILITY ASSURANCE REVIEW

I. PLANT INFORMATION

1. Name: PALO VERDE Unit No. 1 2. Docket No.:

3. Utility: ARIZONA PUBLIC SERVICE

4. NSSS: COMBUSTION ENGINEERING [X] PWR [] BWR

5. A/E: BECHTEL POWER CORPORATION

II. GENERAL COMPONENT* INFORMATION

1. Supplier: [] NSSS [X] BOP

2. Location: a. Building/Room MAIN STEAM SUPPORT STRUCTURE

b. Elevation 140'

c. System MAIN STEAM

3. Component number on in-house drawings: J-SGE-UV-180

4. If component is a [] Pump complete II.5.

If component is a [X] Valve complete II.6.

5. General Pump Data NOT APPLICABLE

a. Pump		b. Prime-mover	
Name		Name	
Mfg.		Mfg.	
Model		Model	
S/N		S/N	
Type		Type	

* The component, whether pump or valve, is considered to be an assembly composed of the body, internals, prime-mover (or actuator) and functional accessories.

NOT APPLICABLE

a. Pump (continued)

Size ______

Weight ______

Mounting Method ______

Required B.H.P. ______

Parameter	Design	Operating
Press		
Temp		
Flow		
Head		

Required NPSH at maximum flow ______

Available NPSH ______

Operating Speed ______

Critical Speed ______

b. Prime-mover (continued)

Size ______

Weight ______

Mounting Method ______

H.P. ______

Power requirements: (include normal, maximum and minimum).

Electrical ______

Other ______

If MOTOR list:

Duty cycle ______

Stall current ______

Class of insulation ______

List functional accessories:* ______

List control signal inputs: ______

* Functional accessories are those sub-components not supplied by the manufacturer that are required to make the pump assembly operational, (e.g., coupling, lubricating oil system, etc.)

6. General Valve Data

a. Valve		b. Actuator (if not an integral unit)	
Name	1-J-SGA-UV-180 MAIN STEAM ISOLATION VALVE	Name	MAIN STEAM ISOLATION VALVE HYDRAULIC ACTUATOR
Mfg.	ANCHOR DARLING	Mfg.	ANCHOR DARLING
Model	CUSTOM BUILT	Model	64324-C
S/N	E 9023-1-2	S/N	001
Type	DOUBLE DISC WEDGE	Type	SELF CONTAINED
Size	28" X 24" X 28"	Size	68" L X 33" DIA.
Weight	19850 LBS	Weight	7600 LBS.
Mounting Method	WELDED ENDS.	Mounting Method	BOLTED
Required Torque	NOT APPLICABLE	Torque	① BODY/BONNET - 3500 FT-LBS. ② BONNET/YOKE LEGS - 1150 " ③ YOKE LEGS/ACTUATOR - 1400 "

Parameter	Design	Operating
Press	1270 PSIG	1037 PSIA
Temp (°F)	575	549
Flow (LB/HR)	4545000	3971050

Max ΔP across valve 983 PSI

Closing time @ max ΔP 5.0 SEC. MAX

Opening time @ max ΔP 5.0 MIN. MAX
ACTUAL - 60 SEC. (OPERATING)

Power requirements: (include normal, maximum and minimum).

Electrical
125 V - DC NORMAL
140 V - DC. MAX.
115 V - DC. MIN.

Other: ☒ Pneumatic ☒ Hydraulic

Power requirements for functional accessories, (if any)
① FOR SOL. VLV. & NAMCO LIMIT SW - 125 V DC.
② FOR ACTUATOR - AIR PR. - 80-125 PSI
N_2 PR. - 3750 PSI

List control signal inputs: FAST OPEN AND CLOSE, SLOW OPEN AND CLOSE, TEST AND EXERCISE (MAIN STEAM ISOLATION SIGNAL)

List functional accessories:* SOLENOID VALVES, LIMIT SWITCHES, PRESSURE TRANSMITTERS, HY'D. ACCUMULATORS, PRESS. SWITCHES.

III. FUNCTION

1. Briefly describe components normal and safety functions: ① NORMALLY OPEN TO SUPPLY MAIN STEAM FROM STM GENERATOR TO H.P. TURBINE. ② SAFETY FUNCTION – CLOSES TO PREVENT STEAM FLOWING FROM THE STM. GEN. TO THE TURBINE INLET MANIFOLD & TO PREVENT BACK FLOW IN THE STEAM GENERATOR PRESSURE DROPS BELOW THE TURBINE INLET MANIFOLD PRESSURE.

2. The components normal state is: [] Operating [X] Standby

3. Safety function:

a. [X] Emergency reactor shutdown

b. [] Containment heat removal

c. [X] Containment isolation

d. [X] Reactor heat removal

e. [] Reactor core cooling

f. [] Prevent significant release of radio-active material to environment

g. [] Does the component function to mitigate the consequences of one or more of the following events? [X] Yes [] No
If "Yes", identify.

[X] LOCA [X] HELS [X] MSLS

[] Other ______

4. Safety requirements:

[X] Intermittent Operation [X] During postulated event

[] Continuous Operation [X] Following postulated event

If component operation is required following an event, give approximate length of time component must remain operational.
REMAIN CLOSED 30 DAYS. (e.g., hours, days, etc.)

---

* Functional accessories are those sub-components not supplied by the manufacturer that are required to make the valve assembly operational, (e.g., limit switches).

5. For VALVES:

does the component [] Fail open [X] Fail closed [] Fail as is

Is this the fail safe position? [X] Yes [] No

Is the valve used for throttling purposes? [] Yes [X] No

Is the valve part of the reactor coolant pressure boundary?
[] Yes [X] No

Does the valve have a specific limit for leakage? [X] Yes [] No

If "Yes" give limit: ① 10 X DIA – (ML/HR), CLOSED NORMALLY
② 0.001 % VWO FLOW, BREAK DOWNSTREAM OF VALVE
③ 0.1 % VWO FLOW, BREAK UPSTREAM OF VALVE

IV. QUALIFICATION

1. Reference by specific number those applicable sections of the design codes and standards applicable to the component:
ANSI – S1.2 (1962), ASME B & PV SECT. II, III, IX, XI
ASTM – E-94, NEMA, OSHA; MSS-SP-45 & 61,
IEEE – 279, 308

2. Reference those qualification standards, used as a guide to qualify the component:
① IEEE – 323 – 1974 ② IEEE – 344 – 1975
③ IEEE – 382 – 1972

3. Identify those parts of the above qualification standards deleted or modified in the qualification program.

NONE

Deleted: Modified:

4. Have acceptance criterias been established and documented in the test plan(s) for the component? [X] Yes [] No

5. What is the expected failure mode that would keep the pump or valve assembly from performing its safety function?
NONE

6. Are the margins* identified in the qualification documentation?
[X] Yes [] No

---

d. Margin is the difference between design basis parameters and the test parameters used for equipment qualification.

If component is a PUMP, complete IV.7.

If component is a VALVE, complete IV.8.

NOT APPLICABLE

7. Pump operability has been demonstrated by: [] Analysis
[] Test [] Combination

Identify PUMP tests performed:

a. [] Shell hydrostatic (ASME Section III)
b. [] Bearing temperature evaluations
c. [] Seismic loading
d. [] Vibration levels
e. [] Exploratory vibration (Fundamental freq._____)
f. [] Seal leakage @ hydro press
g. [] Aging: [] Thermal [] Mechanical
h. [] Flow performance
Are curves provided [] Yes [] No
i. [] Pipe reaction end loads (nozzle loads)
j. [] Others __________
k. [] Extreme environment:
[] Humidity
[] Chemical
[] Radiation

8. Valve operability has been demonstrated by: [] Analysis
[] Test [X] Combination

Identify VALVE tests performed:

a. [X] Shell hydrostatic (ASME Section III)
b. [] Cold cyclic List times:
Open ________
Closed ________
c. [X] Seismic loading
d. [X] Hot cyclic List times:
Open 800
Closed 1200
e. [X] Exploratory vibration (Fundamental freq._____)
f. [] Main seat leakage

g. [X] Aging: [X] Thermal
[X] Mechanical

h. [] Back seat leakage

i. [X] Pipe reaction end loading

j. [X] Disc hydrostatic

k. [X] Extreme environment
- [X] Humidity
- [X] Chemical
- [X] Radiation

l. [] Flow interruption capability

m. [] Flow characteristics
Are curves provided?
[] Yes [] No

n. [] Others ______

9. As a result of any of the tests (or analysis), were any deviations from design requirements identified? [X] Yes [] No If "Yes", briefly describe any changes made in tests (or analysis) or to the component to correct the deviation.

4 WAY SOLENOID VALVES TO WITHSTAND AN ATMOSPHERIC PRESSURE OF 21 PSIG.

10. Was the test component precisely identical (as to model, size, etc.) to the in-plant component? [] Yes [X] No If "No", is installed component [X] oversized or [] undersized?

11. If type test was used to qualify the component, does the type test meet the requirements of IEEE 323-1974, Section 5.? [X] Yes [] No

12. Is component orientation sensitive? [X] Yes [] No [] Unknown If "Yes", does installed orientation coincide with test orientation? [X] Yes [] No

13. Is the component mounted in the same manner in-plant as it was during testing (i.e., welded, same number and size bolts, etc.) [X] Yes [] No [] Unknown

14. Were the qualification tests performed in sequence and on only one component? [] Yes [X] No

If "Yes" identify sequence, (e.g., radiation, seismic, cyclic, thermal, etc.): ____________

15. If "aging"* was performed, identify the significant aging mechanisms: USE OF 10°C RULE. CHAMBER TEMP. MAINTAINED @ 250°F FOR 13.2 DAYS. AIR VELOCITY WITHIN CHAMBER = 250 FPM.

16. Identify loads imposed (assumed) on the component for the qualification tests (analysis) performed:

a. [] Plants (shutdown loads) b. [X] Extreme environment

c. [X] Seismic load d. [] Others ____________

17. Have component design specifications been reviewed in-house to assure they envelope all expected operating, transient, and accident conditions? [X] Yes [] No

18. Does the component utilize any unique or special materials? (Examples are special gaskets or packing, limitations on nonferrous materials, or special coatings or surfaces.)
[X] Yes [] No

If "Yes", identify: (1) JOHN CRANE - 241 AND 1625 GF PACKING RINGS. (2) SOLENOID VALVE COILS (3) LIMIT SWITCHES (4) PRESS. TRANSMITTERS. (5) PRESSURE SWITCHES.

19. Does component require any special maintenance procedures or practices, (including shorter periods between maintenance).
[X] Yes [] No

If "Yes", identify: 2½ YEARS OR LESS MAINT./REPLACEMENT OF NON-METALLIC i.e. ACTUATOR COMPONENTS, SEALS, SOLENOID COILS.

20. Is the qualified life for the component less than 40 years?
[X] Yes [] No If "Yes", what is the qualified life? NON METALLICS HAVE A 2½ YEAR QUALIFIED LIFE.

* As outlined in Section 4.4.1 of IEEE-627 1980.

21. Information Concerning Qualification Documents for the Component

Report Number	Report Title	Date	Company/Organization Preparing Report	Company/Organization Reviewing Report
E 9023 -QR-2 REV. A	QUALIFICATION AND OPERABILITY ASSURANCE REPORT FOR MAIN STEAM AND FEEDWATER ISOLATION VALVES	4-15-80	ANCHOR DARLING	BECHTEL
438 47-2. REV. C	ACTUATOR QUALIFICATION TEST REPORT	7-14-78	WYLE LABORATORIES	BECHTEL
E 6210-IC REV. A	STATIC SEISMIC TEST	4/79	ANCHOR DARLING	BECHTEL
117415	QUALIFICATION TESTS FOR ROSEMOUNT PRESSURE TRANSMITTER MODEL 1152	9/24/75	ROSEMOUNT	BECHTEL
RPT NO NIL REV. 1	QUALIFICATION OF NAMCO CONTROL LIMIT SWITCHE MODEL EA-180	9/5/78	DR. EDWARD J. WALTER & ASSOCIATES	BECHTEL

M-CTA-P01
M-CTB-P01

PUMP AND VALVE OPERABILITY ASSURANCE REVIEW

I. PLANT INFORMATION

1. Name: PALO VERDE Unit No. 1 2. Docket No.: ________
3. Utility: ARIZONA PUBLIC SERVICE
4. NSSS: COMBUSTION ENGINEERING [X] PWR [] BWR
5. A/E: BECHTEL POWER CORPORATION

II. GENERAL COMPONENT* INFORMATION

1. Supplier: [] NSSS [X] BOP
2. Location: a. Building/Room OUTSIDE AREA [PUMP HOUSE ADJACENT TO CONDENSATE STORAGE TANK]
   b. Elevation GROUND LEVEL - 100'
   c. System CONDENSATE TRANSFER
3. Component number on in-house drawings: [M-CTA-P01 M-CTB-P01]
4. If component is a [X] Pump complete II.5.
   If component is a [] Valve complete II.6.
5. General Pump Data

a. Pump		b. Prime-mover	
Name	CONDENSATE TRANSFER PUMP	Name	CONDENSATE TRANSFER PUMP MOTOR
Mfg.	INGERSOLL - RAND	Mfg.	WESTINGHOUSE
Model	2 X 10 AN	Model	TBFC (FRAME # 213T)
S/N	057766	S/N	7903-01-002 SER.
Type	HORIZONTAL CENTRIFUGAL	Type	LLT. SQUIRREL CAGE TYPE B (NEMA)

* The component, whether pump or valve, is considered to be an assembly composed of the body, internals, prime-mover (or actuator) and functional accessories.

a. Pump (continued)			b. Prime-mover (continued)
Size (Overall, Incl. Pump & motor) (60.5" L) X (30.5" H) X (29.25" W)			Size (17.70" L) X (10.86" H) X (11.20" W)
Weight 1085 LBS (Pump & Motor)			Weight 140 LBS
Mounting Method BOLTED TO FOUNDATION			Mounting Method PAD MOUNTED, BOLTED DOWN.
Required B.H.P. 3.36			H.P. 5
Parameter	Design	Operating	Power requirements: (include normal, maximum and minimum).
Press (PSIG)	50	30	Electrical 480 VAC ± 10% (MAX MIN) 60 HZ, 3 PHASE, FULL LOAD CURRENT - 7.0 AMPS.
Temp (°F)	200	120	
Flow (GPM)	130	130	
Head (FT)	61	61	Other SPACE HEATERS (30 W, 120 V, 1 Φ)
Required NPSH at maximum flow 6.5 FT.			If MOTOR list: Duty cycle INTERMITTENT
Available NPSH 24 FT			Stall current 43. AMPS.
Operating Speed 1750			Class of insulation H
Critical Speed 155.3 HZ (RESONANCE)			

List functional accessories:* (1) COUPLING - THOMAS (BY REXNORD) (2) BEARING TEMP THERMOCOUPLES (3) MOTOR SPACE HEATERS (4) MOTOR CONTROL CENTER.

List control signal inputs: (1) (SIAS) SAFETY INJECTION ACTUATION SIGNAL (2) (CREFAS) CONTROL EMERGENCY FILTERATION ACTUATION SIGNAL (3) (CRVIAS) CONTROL ROOM VENTILATION ISOLATION ACTUATION SIGNAL (4) (LOP) LOSS OF OFF-SITE POWER

* Functional accessories are those sub-components not supplied by the manufacturer that are required to make the pump assembly operational, (e.g., coupling, lubricating oil system, etc.)

6. General Valve Data NOT APPLICABLE.

a. Valve

Name ______

Mfg. ______

Model ______

S/N ______

Type ______

Size ______

Weight ______

Mounting Method ______

Required Torque ______

Parameter	Design	Operating
Press	______	______
Temp	______	______
Flow	______	______

Max ΔP across valve ______

Closing time @ max ΔP ______

Opening time @ max ΔP ______

Power requirements for functional accessories, (if any) ______

______

b. Actuator (if not an integral unit)

Name ______

Mfg. ______

Model ______

S/N ______

Type ______

Size ______

Weight ______

Mounting Method ______

Torque ______

Power requirements: (include normal, maximum and minimum).

Electrical ______

______

______

______

Other: [] Pneumatic [] Hydraulic

______

______

______

______

List control signal inputs: ______

______

______

List functional accessories:* ______ / ______

III. FUNCTION

1. Briefly describe components normal and safety functions: NORMAL AND SAFETY FUNCTION IS TO DELIVER EMERGENCY MAKE-UP TO DIESEL GENERATOR COOLING WATER SYSTEM, ESSENTIAL COOLING & CHILLED WATER SYSTEM AND SPENT FUEL POOL

2. The components normal state is: [] Operating [X] Standby (INTERMITTENT)

3. Safety function:

   a. [X] Emergency reactor shutdown
   b. [] Containment heat removal
   c. [] Containment isolation
   d. [] Reactor heat removal
   e. [] Reactor core cooling
   f. [] Prevent significant release of radioactive material to environment
   g. [] Does the component function to mitigate the consequences of one or more of the following events? [X] Yes [] No
      If "Yes", identify.

      [X] LOCA [X] HELS [X] MSLS

      [] Other ______

4. Safety requirements:

   [X] Intermittent Operation [X] During postulated event

   [] Continuous Operation [X] Following postulated event

   If component operation is required following an event, give approximate length of time component must remain operational.

   30 DAYS. (e.g., hours, days, etc.)

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* Functional accessories are those sub-components not supplied by the manufacturer that are required to make the valve assembly operational, (e.g., limit switches).

5. For VALVES: NOT APPLICABLE

does the component [] Fail open [] Fail closed [] Fail as is

Is this the fail safe position? [] Yes [] No

Is the valve used for throttling purposes? [] Yes [] No

Is the valve part of the reactor coolant pressure boundary?
[] Yes [] No

Does the valve have a specific limit for leakage? [] Yes [] No

If "Yes" give limit: ______

IV. QUALIFICATION

1. Reference by specific number those applicable sections of the design codes and standards applicable to the component: ASME SEC. III & XI, ANSI, ASTM, HIS, NEMA, OSHA

2. Reference those qualification standards, used as a guide to qualify the component: IEEE-323-1974 & IEEE-344-1975

3. Identify those parts of the above qualification standards deleted or modified in the qualification program.

Deleted:	Modified:
NONE	NONE

4. Have acceptance criterias been established and documented in the test plan(s) for the component? [X] Yes [] No

5. What is the expected failure mode that would keep the pump or valve assembly from performing its safety function? LOSS OF AC POWER

6. Are the margins* identified in the qualification documentation?
[X] Yes [] No

d. Margin is the difference between design basis parameters and the test parameters used for equipment qualification.

If component is a PUMP, complete IV.7.

If component is a VALVE, complete IV.8.

7. Pump operability has been demonstrated by: [X] Analysis
[] Test [] Combination

Identify PUMP tests performed:

a. [X] Shell hydrostatic (ASME Section III)
b. [] Bearing temperature evaluations
c. [X] Seismic loading
d. [] Vibration levels
e. [X] Exploratory vibration (Fundamental freq. 61.3)
f. [X] Seal leakage @ hydro press
g. [] Aging: [] Thermal [] Mechanical
h. [X] Flow performance
Are curves provided [X] Yes [] No
i. [X] Pipe reaction end loads (nozzle loads)
j. [] Others ____________
k. [] Extreme environment:
[] Humidity ____________
[] Chemical ____________
[] Radiation ____________

8. Valve operability has been demonstrated by: [] Analysis NOT APPLICABLE
[] Test [] Combination

Identify VALVE tests performed:

a. [] Shell hydrostatic (ASME Section III)
b. [] Cold cyclic List times:
Open ________
Closed ________
c. [] Seismic loading
d. [] Hot cyclic List times:
Open ________
Closed ________
e. [] Exploratory vibration (Fundamental freq.____)
f. [] Main seat leakage

g. [] Aging: [] Thermal
[] Mechanical

h. [] Back seat leakage

i. [] Pipe reaction end loading

j. [] Disc hydrostatic

k. [] Extreme environment
[] Humidity
[] Chemical
[] Radiation

l. [] Flow interruption capability

m. [] Flow characteristics
Are curves provided?
[] Yes [] No

n. [] Others ______________

9. As a result of any of the tests (or analysis), were any deviations from design requirements identified? [] Yes [X] No If "Yes", briefly describe any changes made in tests (or analysis) or to the component to correct the deviation.

10. Was the test component precisely identical (as to model, size, etc.) to the in-plant component? [] Yes [] No If "No", is installed component [] oversized or [] undersized? NOT APPLICABLE

11. If type test was used to qualify the component, does the type test meet the requirements of IEEE 323-1974, Section 5.? [] Yes [] No NOT APPLICABLE

12. Is component orientation sensitive? [X] Yes [] No [] Unknown If "Yes", does installed orientation coincide with test orientation? [] Yes [] No NOT APPLICABLE

13. Is the component mounted in the same manner in-plant as it was during testing (i.e., welded, same number and size bolts, etc.) [] Yes [] No [] Unknown NOT APPLICABLE

14. Were the qualification tests performed in sequence and on only one component? [] Yes [] No NOT APPLICABLE

If "Yes" identify sequence, (e.g., radiation, seismic, cyclic, thermal, etc.): ______

15. If "aging"* was performed, identify the significant aging mechanisms: NON-METALLICS HAVE 5 YEAR QUALIFIED LIFE BASED ON AGING ANALYSIS

16. Identify loads imposed (assumed) on the component for the qualification tests (analysis) performed:

a. [] Plants (shutdown loads) b. [] Extreme environment

c. [X] Seismic load d. [] Others ______

17. Have component design specifications been reviewed in-house to assure they envelope all expected operating, transient, and accident conditions? [X] Yes [] No

18. Does the component utilize any unique or special materials? (Examples are special gaskets or packing, limitations on nonferrous materials, or special coatings or surfaces.)
[X] Yes [] No

If "Yes", identify: (1) GASKET - PE 800 (2) WATER SEAL CAGE - TFE (3) GASKET - HYDROIL (4) OIL THROWERS - GLASS FILLED URETHANE

19. Does component require any special maintenance procedures or practices, (including shorter periods between maintenance).
[X] Yes [] No

If "Yes", identify: REFER TO MAINTENANCE MANUAL

20. Is the qualified life for the component less than 40 years?
[] Yes [X] No If "Yes", what is the qualified life? NON-METALLICS HAVE 5 YEAR QUALIFIED LIFE.

* As outlined in Section 4.4.1 of IEEE-627 1980.

21. Information Concerning Qualification Documents for the Component

Report Number	Report Title	Date	Company/Organization Preparing Report	Company/Organization Reviewing Report
EAS-TR-7904-PST REV. 1	STRUCTURAL INTEGRITY ANALYSIS FOR CONDENSATE TRANSFER PUMP 2X10AN	JUNE 9 1979	INGERSOLL - RAND	BECHTEL
NA68903	SEISMIC ANALYSIS OF MOTOR	AUG. 4, 1977	WESTINGHOUSE	BECHTEL
MM9112	QUALIFICATION DOCUMENT FOR CLASS IE MEDIUM MOTORS (OUTSIDE THE CONTAINMENT) PER IEEE-323-1974	JAN 18, 1980	WESTINGHOUSE	BECHTEL

PUMP AND VALVE
OPERABILITY ASSURANCE REVIEW

I. PLANT INFORMATION

1. Name: ANPP Unit No. 1-3 2. Docket No.: ______

3. Utility: ARIZONA PUBLIC SERVICE

4. NSSS: COMBUSTION ENGINEERING (SYSTEM 80) [X] PWR [ ] BWR

5. A/E: BECHTEL POWER CORPORATION

II. GENERAL COMPONENT* INFORMATION

1. Supplier: [ ] NSSS [X] BOP

2. Location: a. Building/Room YARD / OUTSIDE AREA
   b. Elevation 108' 0"
   c. System ESSENTIAL SPRAY POND SYSTEM

3. Component number on in-house drawings: BECHTEL TAG NO. M-SPA-P01 → M-SPB-P01

4. If component is a [X] Pump complete II.5.
   If component is a [ ] Valve complete II.6.

5. General Pump Data

a. Pump		b. Prime-mover	
Name	ESSENTIAL SPRAY POND PUMP	Name	ESSENTIAL SPRAY POND PUMP MOTORS
Mfg.	BINGHAM WILLAMETTE COMPANY	Mfg.	GENERAL ELECTRIC
Model	PA3286	Model	5K6338 X C125A
S/N	1A042	S/N	ERJ314003 (4)
Type	VERTICAL TURBINE PUMP (WET PIT)	Type	AC INDUCTION MOTOR (VERTICAL)

* The component, whether pump or valve, is considered to be an assembly composed of the body, internals, prime-mover (or actuator) and functional accessories.

a. Pump (continued)	b. Prime-mover (continued)
Size 20'x60" (H+DIA) (OUTLET) x (INLET) 24" x 38"	Size 84 1/8" x 36" x 51 1/8"
Weight 17,000 POUNDS	Weight 8200 POUNDS
Mounting Method CONCRETE MOUNTED (PIT)	Mounting Method 10 EA 1/2" BOLTS
Required B.H.P. 589 @ DESIGN	H.P. 600 HP

Parameter	Design	Operating
Press (PSIG)	100	52
Temp (°F)	200	95
Flow (GPM)	16,300	16,900
Head (Ft)	120	118

Power requirements: (include normal, maximum and minimum).

Electrical 4000 VOLTS

3 PHASE

60 HZ

Other SPACE HEATERS 1 PHASE 600 WATTS

THERMOCOUPLES (BEARING)

Required NPSH at maximum flow SUBMERGENCE 6'-0"

Available NPSH 6'-6"

Operating Speed 880 RPM

Critical Speed 2500 RPM

If MOTOR list:

Duty cycle DISCONTINUOUS / 60 HZ

Stall current 492 AMPS

Class of insulation CLASS F

List functional accessories:*

ELECTRICAL STARTERS AND SWITCHGEAR

FOUNDATIONS AND ANCHOR BOLTS

List control signal inputs: ACTUATION UPON: START OF DIESEL GENERATOR, A SAFETY INJECTION ACTUATION SIGNAL, A CONTROL ROOM EMERGENCY FILTRATION ACTUATION SIGNAL, A CONTROL ROOM VENTILATION ISOLATION ACTUATION SIGNAL

* Functional accessories are those sub-components not supplied by the manufacturer that are required to make the pump assembly operational, (e.g., coupling, lubricating oil system, etc.)

6. General Valve Data N/A

a. Valve

Name ______

Mfg. ______

Model ______

S/N ______

Type ______

Size ______

Weight ______

Mounting Method ______

Required Torque ______

Parameter	Design	Operating
Press		
Temp		
Flow		

Max ΔP across valve ______

Closing time @ max $\overline{\Delta}$P ______

Opening time @ max $\overline{\Delta}$P ______

Power requirements for functional accessories, (if any) ______

______

b. Actuator (if not an integral unit)

Name ______

Mfg. ______

Model ______

S/N ______

Type ______

Size ______

Weight ______

Mounting Method ______

Torque ______

Power requirements: (include normal, maximum and minimum).

Electrical ______

______

______

______

Other: [] Pneumatic [] Hydraulic

______

______

______

______

List control signal inputs: ______

______

______

List functional accessories:* ______________________________

____

III. FUNCTION

1. Briefly describe components normal and safety functions: ______

1. PROVIDES COOLING WATER TO ESSENTIAL COOLING WATER HEAT EXCHANGER DURING NORMAL OR EMERGENCY PLANT SHUTDOWN. 2. PROVIDES COOLING WATER TO THE DIESEL GENERATOR HEAT EXCHANGER WHEN THE DIESEL GENERATOR IS RUNNING.

2. The components normal state is: [] Operating [X] Standby

3. Safety function:

a. [X] Emergency reactor shutdown

b. [X] Containment heat removal

c. [] Containment isolation

d. [X] Reactor heat removal

e. [X] Reactor core cooling

f. [] Prevent significant release of radioactive material to environment

g. [] Does the component function to mitigate the consequences of one or more of the following events? [X] Yes [] No
If "Yes", identify.

[X] LOCA [X] HELB [X] MSLB

[] Other ______________________________

4. Safety requirements:

[] Intermittent Operation [X] During postulated event

[X] Continuous Operation [X] Following postulated event

If component operation is required following an event, give approximate length of time component must remain operational.

30 DAYS : (e.g., hours, days, etc.)

* Functional accessories are those sub-components not supplied by the manufacturer that are required to make the valve assembly operational, (e.g., limit switches).

5. For VALVES:

does the component [] Fail open [] Fail closed [] Fail as is

Is this the fail safe position? [] Yes [] No

Is the valve used for throttling purposes? [] Yes [] No

Is the valve part of the reactor coolant pressure boundary?
[] Yes [] No

Does the valve have a specific limit for leakage? [] Yes [] No

If "Yes" give limit: ______

IV. QUALIFICATION

1. Reference by specific number those applicable sections of the design codes and standards applicable to the component: ______

ASME SECTION III AND SECTION XI

2. Reference those qualification standards, used as a guide to qualify the component: ______

APPLICABLE SECTIONS NRC REG GUIDE 1.48 MAY 1973
AND IEEE 323-74, 334-74 & 344-75

3. Identify those parts of the above qualification standards deleted or modified in the qualification program.
N/A
Deleted: Modified:

4. Have acceptance criterias been established and documented in the test plan(s) for the component? [X] Yes [] No

5. What is the expected failure mode that would keep the pump or valve assembly from performing its safety function? ______

BEARING FAILURE

6. Are the margins* identified in the qualification documentation?
[] Yes [X] No

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d. Margin is the difference between design basis parameters and the test parameters used for equipment qualification.

If component is a PUMP, complete IV.7.

If component is a VALVE, complete IV.8.

7. Pump operability has been demonstrated by: [] Analysis
[] Test [X] Combination

Identify PUMP tests performed:

a. [X] Shell hydrostatic (ASME Section III)
b. [X] Bearing temperature evaluations MOTOR QUALIFICATION REPORT
c. [X] Seismic loading
d. [X] Vibration levels
e. [X] Exploratory vibration (Fundamental freq. 32.27) CYCLE/SEC
f. [X] Seal leakage @ hydro press
g. [X] Aging: [X] Thermal [] Mechanical
h. [X] Flow performance
Are curves provided [X] Yes [] No
i. [X] Pipe reaction end loads (nozzle loads) STRESS ANALYSIS
j. [] Others ______
k. [] Extreme environment: ______
[] Humidity ______
[] Chemical ______
[] Radiation ______

8. Valve operability has been demonstrated by: [] Analysis
[] Test [] Combination

Identify VALVE tests performed:

a. [] Shell hydrostatic (ASME Section III)
b. [] Cold cyclic List times:
Open ______
Closed ______
c. [] Seismic loading
d. [] Hot cyclic List times:
Open ______
Closed ______
e. [] Exploratory vibration (Fundamental freq.____)
f. [] Main seat leakage

g. [] Aging: [] Thermal
[] Mechanical

h. [] Back seat leakage

i. [] Pipe reaction end loading

j. [] Disc hydrostatic

k. [] Extreme environment

[] Humidity

[] Chemical

[] Radiation

l. [] Flow interruption capability

m. [] Flow characteristics

Are curves provided?

[] Yes [] No

n. [] Others ____________________

____

____

9. As a result of any of the tests (or analysis), were any deviations from design requirements identified? [] Yes [X] No If "Yes", briefly describe any changes made in tests (or analysis) or to the component to correct the deviation.

____

____

____

10. Was the test component precisely identical (as to model, size, etc.) to the in-plant component? [X] Yes [] No If "No", is installed component [] oversized or [] undersized?

11. If type test was used to qualify the component, does the type test meet the requirements of IEEE 323-1974, Section 5.?4
[X] Yes [] No

12. Is component orientation sensitive? [X] Yes [] No [] Unknown If "Yes", does installed orientation coincide with test orientation? [X] Yes [] No

13. Is the component mounted in the same manner in-plant as it was during testing (i.e., welded, same number and size bolts, etc.) [X] Yes [] No [] Unknown

14. Were the qualification tests performed in sequence and on only one component? [] Yes [X] No

If "Yes" identify sequence, (e.g., radiation, seismic, cyclic, thermal, etc.): ______

15. If "aging"* was performed, identify the significant aging mechanisms: N.A. (NO SIGNIFICANT AGING MECHANISMS)

16. Identify loads imposed (assumed) on the component for the qualification tests (analysis) performed:

a. [] Plants (shutdown loads)

b. [] Extreme environment

c. [X] Seismic load

d. [X] Others NOZZLE LOADS, DEADWEIGHT, AND INTERNAL PRESSURE OF 150 PSI

17. Have component design specifications been reviewed in-house to assure they envelope all expected operating, transient, and accident conditions? [X] Yes [] No

18. Does the component utilize any unique or special materials? (Examples are special gaskets or packing, limitations on nonferrous materials, or special coatings or surfaces.) [X] Yes [] No

If "Yes", identify: BUNA-N ORINGS AND GASKETS HAVE A 5 YEAR REPLACEMENT LIFE

19. Does component require any special maintenance procedures or practices, (including shorter periods between maintenance). [] Yes [X] No

If "Yes", identify: ______

20. Is the qualified life for the component less than 40 years? [] Yes [X] No If "Yes", what is the qualified life? ______

* As outlined in Section 4.4.1 of IEEE-627 1980.

21. Information Concerning Qualification Documents for the Component

Report Number	Report Title	Date	Company/Organization Preparing Report	Company/Organization Reviewing Report
1A041/46	ESSENTIAL SPRAY POND PUMP SEISMIC ANALYSIS BECHTEL LOG NO. M095-80	11/1/79	BINGHAM WILLAMETTE	BECHTEL
491 HA-483	QUALIFICATION REPORT OF GE VERTICAL INDUCTION MOTOR BECHTEL LOG M095-74	3/20/79	GENERAL ELECTRIC	BECHTEL
1A041	INSTRUCTION MANUAL	2/17/82	BINGHAM WILLAMETTE	BECHTEL
57537	AGING ANALYSIS FOR ESP PUMPS	7/9/81	WYLE	BECHTEL

PM-221A
HPA UV-3
(HP-UV-3)

PUMP AND VALVE
OPERABILITY ASSURANCE REVIEW

I. PLANT INFORMATION

1. Name: PVNGS Unit No. 1,2,&3 2. Docket No.: STN 50-528/529/530

3. Utility: ARIZONA PUBLIC SERVICE

4. NSSS: COMBUSTION ENGINEERING [X] PWR [] BWR

5. A/E: BECHTEL POWER CORP.

II. GENERAL COMPONENT* INFORMATION

1. Supplier: [] NSSS [X] BOP

2. Location: a. Building/Room AUXILIARY BLD.

b. Elevation 90'

c. System HYDROGEN PURGE (HP)

3. Component number on in-house drawings: TAG NO. 1HPA-UV-003

4. If component is a [] Pump complete II.5.

If component is a [X] Valve complete II.6.

5. General Pump Data

a. Pump	N/A	b. Prime-mover	N/A
Name		Name	
Mfg.		Mfg.	
Model		Model	
S/N		S/N	
Type		Type	

* The component, whether pump or valve, is considered to be an assembly composed of the body, internals, prime-mover (or actuator) and functional accessories.

N/A N/A

a. Pump (continued)

Size __________

Weight __________

Mounting Method __________

Required B.H.P. __________

Parameter	Design	Operating
Press		
Temp		
Flow		
Head		

Required NPSH at maximum flow __________

Available NPSH __________

Operating Speed __________

Critical Speed __________

b. Prime-mover (continued)

Size __________

Weight __________

Mounting Method __________

H.P. __________

Power requirements: (include normal, maximum and minimum).

Electrical __________

Other __________

If MOTOR list:

Duty cycle __________

Stall current __________

Class of insulation __________

List functional accessories:* __________

List control signal inputs: __________

* Functional accessories are those sub-components not supplied by the manufacturer that are required to make the pump assembly operational, (e.g., coupling, lubricating oil system, etc.)

6. General Valve Data

a. Valve

Name DRESSER HANCOCK

Mfg. DRESSER INDUSTRIES

Model 5500W

S/N H649AAY

Type GATE (MOV)

Size 2" - 600#

Weight 24.5 lbs

Mounting Method CIRCUMFERENTIAL SOCKET WELD

Required Torque N/A

Parameter	Design	Operating
Pres (PSIG)	60	60
Temp (°F)	350	180
Flow (GPM)	60	50

Max ΔP across valve 70 PSIG

Closing time @ max ΔP CYCLE @

Opening time @ max ΔP 670 psig = 10.7 sec/CYCLE MAX

Power requirements for functional accessories, (if any) NOT APPLICABLE

b. Actuator (if not an integral unit)

Name ROTORK

Mfg. ROTORK

Model 7NAB1-43

S/N B5520.D3

Type ELECTRIC AC.

Size APPROX 30" x 19" x 20"

Weight 128 lbs

Mounting Method BOLT

Torque —

Power requirements: (include normal, maximum and minimum).

Electrical VOLTAGE 460 / 414 / 506 (NORM. / MIN / MAX)

AMPS @ Full load / STALLED ROTOR 1.3/2.1

HP/RPM .13/43

Other: [] Pneumatic [] Hydraulic

List control signal inputs: CIAS

List functional accessories:* NONE

III. FUNCTION

1. Briefly describe components normal and safety functions:

SAFETY FUNCTION: THE VALVE MUST OPERATE (OPEN OR CLOSE) DURING & AFTER AN SSE OR OBE.

THIS VALVE IS NORMALLY CLOSED.

2. The components normal state is: [] Operating [X] Standby

3. Safety function:

   a. [] Emergency reactor shutdown
   b. [] Containment heat removal
   c. [] Containment isolation
   d. [] Reactor heat removal
   e. [] Reactor core cooling
   f. [X] Prevent significant release of radioactive material to environment
   g. [] Does the component function to mitigate the consequences of one or more of the following events? [X] Yes [] No If "Yes", identify.

      [X] LOCA [] HELB [] MSLB

      [] Other

4. Safety requirements:

   [X] Intermittent Operation [X] During postulated event

   [] Continuous Operation [X] Following postulated event

   If component operation is required following an event, give approximate length of time component must remain operational.

   30 DAYS AFTER EVENT (e.g., hours, days, etc.)

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* Functional accessories are those sub-components not supplied by the manufacturer that are required to make the valve assembly operational, (e.g., limit switches).

5. For VALVES:

does the component [] Fail open [] Fail closed [X] Fail as is

Is this the fail safe position? [X] Yes [] No

Is the valve used for throttling purposes? [] Yes [X] No

Is the valve part of the reactor coolant pressure boundary?
[] Yes [X] No

Does the valve have a specific limit for leakage? [X] Yes [] No

If "Yes" give limit: MAIN SEAT 2cc/HR/IN DIA.

IV. QUALIFICATION

1. Reference by specific number those applicable sections of the design codes and standards applicable to the component: ASME B&PV CODE SECTION III DIV 1 SUBSECTION ND 1974 EDITION WITH SUMMER OF 1975 ADDENDA. SPECIFICATION 10407-13PM221A

2. Reference those qualification standards, used as a guide to qualify the component: DESIGN SPECIFICATION 10407-13PM221A. IEEE 323-1974 627-1980, 344-1975, 382-1972 NUREG 0588

3. Identify those parts of the above qualification standards deleted or modified in the qualification program.

Deleted: Modified:

4. Have acceptance criterias been established and documented in the test plan(s) for the component? [X] Yes [] No

5. What is the expected failure mode that would keep the pump or valve assembly from performing its safety function? LOSS OF AC POWER SUPPLY

6. Are the margins* identified in the qualification documentation?
[X] Yes [] No

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d. Margin is the difference between design basis parameters and the test parameters used for equipment qualification.

If component is a PUMP, complete IV.7.

If component is a VALVE, complete IV.8.

N/A

7. Pump operability has been demonstrated by: [] Analysis
[] Test [] Combination

Identify PUMP tests performed:

a. [] Shell hydrostatic (ASME Section III)

b. [] Bearing temperature evaluations

c. [] Seismic loading

d. [] Vibration levels

e. [] Exploratory vibration (Fundamental freq._____)

f. [] Seal leakage @ hydro press

g. [] Aging: [] Thermal [] Mechanical

h. [] Flow performance
Are curves provided [] Yes [] No

i. [] Pipe reaction end loads (nozzle loads)

j. [] Others __________

k. [] Extreme environment:
[] Humidity __________
[] Chemical __________
[] Radiation __________

8. Valve operability has been demonstrated by: [] Analysis
[] Test [X] Combination

Identify VALVE tests performed:

a. [X] Shell hydrostatic (ASME Section III)

b. [X] Cold cyclic List times:
Open 27
Closed 27

c. [X] Seismic loading

d. [] Hot cyclic List times:
Open __________
Closed __________

e. [X] *Exploratory vibration (Fundamental freq. >33 HZ)

f. [X] Main seat leakage

* ACTUATOR ONLY

*ACTUATOR TEST ONLY

g. [X] Aging: [X] Thermal
[X] Mechanical*

h. [] Back seat leakage

i. [] Pipe reaction end loading

j. [] Disc hydrostatic

k. [X] *Extreme environment
[X] Humidity
[X] Chemical
[X] Radiation

l. [] Flow interruption capability

m. [] Flow characteristics
Are curves provided?
[] Yes [] No

n. [] Others ________ NOT APPLICABLE

9. As a result of any of the tests (or analysis), were any deviations from design requirements identified? [] Yes [X] No
If "Yes", briefly describe any changes made in tests (or analysis) or to the component to correct the deviation.

10. Was the test component precisely identical (as to model, size, etc.) to the in-plant component? [] Yes [X] No If "No", is installed component [] oversized or [X] undersized? *

11. If type test was used to qualify the component, does the type test meet the requirements of IEEE 323-1974, Section 5.?
[X] Yes [] No

12. Is component orientation sensitive? [] Yes [X] No [] Unknown
If "Yes", does installed orientation coincide with test orientation? [] Yes [] No

13. Is the component mounted in the same manner in-plant as it was during testing (i.e., welded, same number and size bolts, etc.)
[] Yes [X] No [] Unknown

(WORST CASE WAS TESTED)

14. Were the qualification tests performed in sequence and on only one component? [X] Yes ** [] No ** ACTUATOR ONLY

If "Yes" identify sequence, (e.g., radiation, seismic, cyclic, thermal, etc.): BASELINE FUCTIONAL, ENVIRONMENTAL & MECHANICAL WEAR AGING TEST & POST TESTS, PRESSURIZATION AGING TESTS & FUNCTIONAL, RADIATION AGING & FUNCTIONALS, PLANT VIBRATION & SEISMIC, DBE(LOCA) & FUNCTIONAL

15. If "aging"* was performed, identify the significant aging mechanisms: (MECHANICAL, PRESSURIZATION, RADIATION)**

TIME/TEMPERATURE & RADIATION*

* VALVE ONLY

16. Identify loads imposed (assumed) on the component for the qualification tests (analysis) performed:

a. [X] Plants (shutdown loads) b. [X] Extreme environment

c. [X] Seismic load d. [] Others ______

17. Have component design specifications been reviewed in-house to assure they envelope all expected operating, transient, and accident conditions? [X] Yes [] No

18. Does the component utilize any unique or special materials? (Examples are special gaskets or packing, limitations on nonferrous materials, or special coatings or surfaces.) [] Yes [X] No

If "Yes", identify: ______

19. Does component require any special maintenance procedures or practices, (including shorter periods between maintenance). [] Yes [X] No

If "Yes", identify: ______

20. Is the qualified life for the component less than 40 years? [] Yes [X] No If "Yes", what is the qualified life? ______

* As outlined in Section 4.4.1 of IEEE-627 1980.

21. Information Concerning Qualification Documents for the Component

Report Number	Report Title	Date	Company/Organization Preparing Report	Company/Organization Reviewing Report
P221A-137,	Seismic Qualification Procedure PT-76 (Valve Assembly)	9-20-78	Dresser Valve Co.	Bechtel Power Corp.
180,	Certification of Design Report SR-178 (Valve Assembly)	10-7-81	Dresser Valve Co	
165	Qualification Test Report for Rotork	12-19-78	Wyle Laboratories	
188	16NATI Thermal Aging Type-Test Program	2-9-81	Wyle Laboratories	
200	16NATI Thermal Aging Type Test Report TR-3029	1-18-82	Rotork	
201	16 NATI Thermal Aging Type Test Report TR-3030	1-18-82	Rotork	
EM-600-5	Nuclear Environmental Evaluation Report of Valve Packing & Gaskets used in Dresser Valves	12-31-81	Wyle Laboratories	

P221-B
AFA-V-007

PUMP AND VALVE
OPERABILITY ASSURANCE REVIEW

I. PLANT INFORMATION

1. Name: PVNGS Unit No. 1,2,3 2. Docket No.: STN-50-528/529/530

3. Utility: ARIZONA PUBLIC SERVICE

4. NSSS: COMBUSTION ENGINEERING [X] PWR [] BWR

5. A/E: BECHTEL POWER CORP.

II. GENERAL COMPONENT* INFORMATION

1. Supplier: [] NSSS [X] BOP

2. Location: a. Building/Room MSSS

b. Elevation 90'

c. System AUX. FEEDWATER (AF)

3. Component number on in-house drawings: 1PAFAV007

4. If component is a [] Pump complete II.5.

If component is a [X] Valve complete II.6.

5. General Pump Data N/A

a. Pump	N/A	b. Prime-mover	N/A
Name		Name	
Mfg.		Mfg.	
Model		Model	
S/N		S/N	
Type		Type	

---

* The component, whether pump or valve, is considered to be an assembly composed of the body, internals, prime-mover (or actuator) and functional accessories.

N/A N/A

a. Pump (continued)

Size ____________________

Weight ____________________

Mounting Method ____________________

Required B.H.P. ____________________

Parameter	Design	Operating
Press	____	____
Temp	____	____
Flow	____	____
Head	____	____

Required NPSH at maximum flow ____________________

Available NPSH ____________________

Operating Speed ____________________

Critical Speed ____________________

b. Prime-mover (continued)

Size ____________________

Weight ____________________

Mounting Method ____________________

H.P. ____________________

Power requirements: (include normal, maximum and minimum).

Electrical ____________________

____

____

Other ____________________

____

If MOTOR list:

Duty cycle ____________________

Stall current ____________________

Class of insulation ____________________

____

List functional accessories:* ____________________

____

____

List control signal inputs: ____________________

____

____

---

* Functional accessories are those sub-components not supplied by the manufacturer that are required to make the pump assembly operational, (e.g., coupling, lubricating oil system, etc.)

6. General Valve Data

a. Valve

Name	ANCHOR/DARLING
Mfg.	ANCHOR/DARLING VALVE CO.
Model	STD No. 5746-3, 86, 100
S/N	3N 1124
Type	SS. SWING CHECK
Size	8" - 150#
Weight	300 lbs. (APPROX)
Mounting Method	CIRCUMFERENTIAL BUTT WELD
Required Torque	N/A

Parameter	Design	Operating
Press(PSIG)	30*	25
Temp(°F)	120	75
Flow(GPM)	1010	1010

Max ΔP across valve 3 PSI

Closing time @ max ΔP N/A

Opening time @ max ΔP N/A

Power requirements for functional accessories, (if any) N/A

b. Actuator (if not an integral unit)

Name N/A

Mfg.

Model

S/N

Type

Size

Weight

Mounting Method

Torque

Power requirements: (include normal, maximum and minimum).

Electrical

Other: [] Pneumatic [] Hydraulic

List control signal inputs: N/A

*Design pressure of the system. Mfr. design press. of the valve is 275 psi max., 150 psi rated.

List functional accessories:* N/A

III. FUNCTION

1. Briefly describe components normal and safety functions: NON ACTIVE VALVE; SAFETY FUNCTION → PRESERVE THE PRESSURE-RETAINING INTEGRITY OF THE SYSTEM DURING AN SSE AND OBE. NORMAL OPERATION: PRESERVE PRESSURE INTEGRITY & ALLOW FLOW IN ONLY ONE DIRECTION,

2. The components normal state is: [] Operating [X] Standby

3. Safety function:

   a. [X] Emergency reactor shutdown
   b. [] Containment heat removal
   c. [] Containment isolation
   d. [X] Reactor heat removal
   e. [X] Reactor core cooling
   f. [] Prevent significant release of radio-active material to environment
   g. [] Does the component function to mitigate the consequences of one or more of the following events? [X] Yes [] No
      If "Yes", identify.

      [X] LOCA [X] HELB [X] MSLB

      [] Other

4. Safety requirements:

   [] Intermittent Operation [X] During postulated event

   [X] Continuous Operation [X] Following postulated event

   If component operation is required following an event, give approximate length of time component must remain operational.

   7 days (e.g., hours, days, etc.)

* Functional accessories are those sub-components not supplied by the manufacturer that are required to make the valve assembly operational, (e.g., limit switches).

5. For VALVES:

does the component [] Fail open [] Fail closed [] Fail as is NOT APPLICABLE

Is this the fail safe position? [] Yes [] No

Is the valve used for throttling purposes? [] Yes [X] No

Is the valve part of the reactor coolant pressure boundary?
[] Yes [X] No

Does the valve have a specific limit for leakage? [X] Yes [] No

If "Yes" give limit: MAIN SEAT 40 ML/hr (MSS SP61)

IV. QUALIFICATION

1. Reference by specific number those applicable sections of the design codes and standards applicable to the component:

ASME B&PV CODE SECTION III DIV. 1 SUBSECTION ND

1974 EDITION WITH SUMMER OF 1975 ADDENDA. SPECIFICATION 10407-13PM221B

2. Reference those qualification standards, used as a guide to qualify the component: ASME B&PV CODE SECTION III & IEEE 627-1980

3. Identify those parts of the above qualification standards deleted or modified in the qualification program.

Deleted: Modified:

4. Have acceptance criterias been established and documented in the test plan(s) for the component? [X] Yes [] No

5. What is the expected failure mode that would keep the pump or valve assembly from performing its safety function? NONE

6. Are the margins* identified in the qualification documentation?
[X] Yes [] No

d. Margin is the difference between design basis parameters and the test parameters used for equipment qualification.

If component is a PUMP, complete IV.7.

If component is a VALVE, complete IV.8.

7. Pump operability has been demonstrated by: [] Analysis
[] Test [] Combination

N/A

Identify PUMP tests performed:

a. [] Shell hydrostatic (ASME Section III)

b. [] Bearing temperature evaluations

c. [] Seismic loading

d. [] Vibration levels

e. [] Exploratory vibration (Fundamental freq.____)

f. [] Seal leakage @ hydro press

g. [] Aging: [] Thermal [] Mechanical

h. [] Flow performance
Are curves provided [] Yes [] No

i. [] Pipe reaction end loads (nozzle loads)

j. [] Others ____________

k. [] Extreme environment:
[] Humidity
[] Chemical
[] Radiation

8. Valve operability has been demonstrated by: [X] Analysis
[] Test [] Combination

Identify VALVE tests performed:

a. [X] Shell hydrostatic (ASME Section III)

b. [] Cold cyclic List times:
Open ________
Closed ________

c. [] Seismic loading

d. [] Hot cyclic List times:
Open ________
Closed ________

e. [] Exploratory vibration (Fundamental freq.____)

f. [X] Main seat leakage

* ANALYSIS GASKETS

g. [] *Aging: [X] Thermal [] Mechanical

h. [] Back seat leakage

i. [] Pipe reaction end loading

j. [] Disc hydrostatic

k. [] Extreme environment
   [] Humidity
   [] Chemical
   [] Radiation

l. [] Flow interruption capability

m. [] Flow characteristics
   Are curves provided?
   [] Yes [] No

n. [] Others ______________

9. As a result of any of the tests (or analysis), were any deviations from design requirements identified? [] Yes [X] No If "Yes", briefly describe any changes made in tests (or analysis) or to the component to correct the deviation.

____

____

____

10. Was the test component precisely identical (as to model, size, etc.) to the in-plant component? [X] Yes [] No If "No", is installed component [] oversized or [] undersized?

11. If type test was used to qualify the component, does the type test meet the requirements of IEEE 323-1974, Section 5.? [] Yes [] No N/A

12. Is component orientation sensitive? [X] Yes [] No [] Unknown If "Yes", does installed orientation coincide with test orientation? [X] Yes [] No

13. Is the component mounted in the same manner in-plant as it was during testing (i.e., welded, same number and size bolts, etc.) [] Yes [] No [] Unknown N/A

14. Were the qualification tests performed in sequence and on only one component? [] Yes [] No N/A

If "Yes" identify sequence, (e.g., radiation, seismic, cyclic, thermal, etc.): ______

15. If "aging"* was performed, identify the significant aging mechanisms: TIME / TEMPERATURE & RADIATION ANALYSIS FOR GASKETS AND PACKING

16. Identify loads imposed (assumed) on the component for the qualification tests (analysis) performed:

a. [] Plants (shutdown loads) b. [] Extreme environment

c. [X] Seismic load d. [] Others ______

17. Have component design specifications been reviewed in-house to assure they envelope all expected operating, transient, and accident conditions? [X] Yes [] No

18. Does the component utilize any unique or special materials? (Examples are special gaskets or packing, limitations on nonferrous materials, or special coatings or surfaces.)
[] Yes [X] No

If "Yes", identify: ______

19. Does component require any special maintenance procedures or practices, (including shorter periods between maintenance).
[] Yes [X] No

If "Yes", identify: ______

20. Is the qualified life for the component less than 40 years?
[] Yes [X] No If "Yes", what is the qualified life? ______

* As outlined in Section 4.4.1 of IEEE-627 1980.

21. Information Concerning Qualification Documents for the Component

Report Number	Report Title	Date	Company/Organization Preparing Report	Company/Organization Reviewing Report
PM-221B-382	SEISMIC ANALYSIS FOR PO ITEM # 56 8"-150# S.S. SWING CHECK VALVE	6/82	ANCHOR/DARLING VALVE CO.	[illegible]
EM-600-5	NUCLEAR ENVIRONMENTAL EVALUATION REPORT OF VALVE PACKING & GASKETS USED IN ANCHOR/DARLING VALVES	12-3-82	WYLE LABORATORIES	BECHTEL