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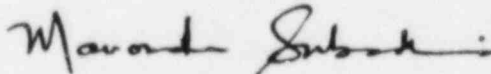
Mr. Vince Noonan, Chief
Equipment Qualification Branch
MS P-1030
Phillips Building
U.S. Nuclear Regulatory Commission
7920 Norfolk Avenue
Bethesda, MD 20814

Dear Mr. Noonan:

Enclosed please find the BNL review comments in the Supplemental Safety Evaluation Reports for Byron Second SQRT Audit. The original report summarizes the reviews at the plant site audit, where the Addendum Report includes some resolutions based on the January 3, 1984 submittal by the applicant.

If you have any further questions, please feel free to contact me.

Sincerely,



Mano Subudhi, Group Leader
Qualification Analysis Group

jm
Enc.

cc: A. Lee, NRC
M. Reich w/o enc.
C. Hofmayer w/o enc.

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Byron Nuclear Power Station - Unit 1
Second SQRT Audit Report

The first Seismic Qualification Review Team (SQRT) audit of the Byron Nuclear Power Station Unit 1 took place during the week of September 13-17, 1982. A total number of twenty-five pieces of equipment were reviewed at the site and a BNL letter report, dated November 17, 1982, describing all the generic as well as equipment specific open items was issued. A short description of the review process and findings associated with each equipment was also included in the report.

In response to the BNL report, the applicant submitted a package of information dated July 7, 1983. These include some documentations, revised SQRT forms and description of resolutions to each issue raised at the SQRT audit. Upon reviewing these submittals, the staff decided to have a second SQRT audit to the plant site. Based on this review, twelve of the twenty-five pieces of equipment chosen originally, needed a second review and seven of them needed to be visited for installation review. The remaining equipment items were considered to have satisfied the design requirements. In addition to the above list, two new pieces of equipment were selected for this audit.

The second SQRT audit was conducted during the week of November 7-9, 1983 at the plant site. The review team was composed of M. Subudhi and J. Curreri of BNL and A. Lee of NRC. The following is the list of the specific equipment audited during the site visit:

I. Equipment Required for Qualification Document Review

1. BOP/1: Electrical Penetration Assemblies
2. BOP/3: Fuse Panel and Associated Instruments
3. BOP/4: Level Switches
4. BOP/7: Motor-Operated Global Valve
5. BOP/8: Motor-Operated Gate Valve
6. BOP/10: Motor-Operated Butterfly Valve
7. BOP/11: Auxiliary Feedwater Pump and Drives
8. NSSS/16: PAM Indicators

I. Equipment Required for Qualification Document Review (Cont'd)

9. NSSS/17: Main Control Board
10. NSSS/21: Motor Operated Gate Valve
11. NSSS/22: Motor Operated Gate Valve (ASME Class 2)
12. NSSS/24: Safety Injection Pump

II. Equipment Required for Installation Review

1. BOP/3: Fuse Panel and Associated Instruments
2. BOP/6: Hydrogen Recombiner
3. NSSS/16: PAM Indicators
4. NSSS/17: Main Control Board
5. NSSS/18: CRDM
6. NSSS/19: RTD
7. NSSS/23: RHR Pump and Motor

III. New Equipment Selected for Second SQRT Audit

1. BOP/S1: Motor Control Center (MCC)
2. NSSS/S1: Power Operated Relief Valve (PORV)

The issues relating to equipment not listed above were resolved based on the applicant's July 7, 1983 submittals. In addition, eleven generic concerns which were raised during the first SQRT audit, were also discussed at the second audit.

This report summarizes BNL comments on the resolutions submitted by the applicant as well as on the reviews conducted during second site audit. These comments are related to the twenty-five pieces of equipment originally selected for the first SQRT audit and the additional two pieces for the second inspection trip. With respect to the eleven generic concerns, the staff found them satisfactory during the second site audit except for the issue relating to the surveillance and maintenance program for equipment in both mild as well

as harsh environments. The utility company has agreed to provide NRC with a satisfactory response which will include some sample examples of their procedure.

In general, based on the audit findings the equipment qualification status at the plant is found satisfactory. Details of the equipment-specific evaluation comments by the SQRT are continued in the individual equipment reports that follow.

BOP/1: Electrical Penetration Assemblies (EPA)

The reports describing the environmental aging and qualification testing were reviewed at the site. These reports are:

- (1) Conax Report IPS-585-3, "Design Qualification Test Report of a Low Voltage Power and Control", EPA, Rev. A, 2-10-81.
- (2) Conax Report IPC-325, "Design Qualification Material Test Report for Materials Used in Conax EPA and Seal Assemblies", Rev. D, 5-14-81.
- (3) Conax Report IPS-369, "Design Qualification Report for EPA for Bryon/Braidwod, Unit 1", Rev. D, 2-8-83.

Based on the findings reported in the above documents, the EPA's are considered to be qualified for a life of 40 years. The test sequence and procedure are performed as per the IEEE-323, 1974 requirements.

The issue relating to the non-seismic categorization of the Nitrogen Supply System was resolved on the basis that unlike the Bunker Remo EPA, the Conax units operate with air instead of Nitrogen. The Nitrogen Supply System serves as an additional design feature for monitoring the safety of these units.

Based on these findings, the EPA units installed at Byron site are considered qualified for the seismic environment.

BOP/2: 6900V Switchgear

The issues relating to the qualification of the equipment can be considered insignificant for its safe operation. The documentation errors are of generic in nature and are resolved during the second site audit.

BOP/3: Fuse Panel and Associated Instruments

The applicant has provided responses to the three open items.

The first open item relates to the need for tests to demonstrate the functional operability of the Class 1E devices installed in the fuse panel cabinet. Such tests are being conducted, as mentioned in the applicant's response, and the test report is due before fuel load, (December 1983). In order to close this item, the applicant should submit the test report for our review.

The second item relates to the completion of the cabinet installation. The applicant has verified that the cabinet installation is complete. Furthermore, the provisions in place to ensure complete installation of all equipment items are described in response to Generic Item 1. Therefore, this item is considered closed.

The third item relates to the error found on the SQRT form concerning the description of the mounting conditions for the fuse panel cabinet. This error has been corrected on a revised SQRT form; therefore, this item is closed.

Since additional information is required to resolve the first item, no conclusions can be drawn for this equipment.

BOP/4: Level Switches

During the previous audit on the week of September 13, 1982 a microfiche copy of the Wyle Lab Test Report No. 43235-1 was reviewed. That report contains information only on seismic tests.

The qualification documents that were reviewed on 11/8/83 contained a Wyle Laboratory Report No. 17615-1, dated 12/20/82. It discusses a qualifi-

cation test program to satisfy the intent of IEEE 323-1974. The test program included:

- Baseline functional tests
- Thermal aging
- Post-thermal aging functional tests
- Seismic qualification
- Post-seismic qualification functional tests

The results of the tests were reviewed by John M. Horne, P.E., Supervisor, Applied Mechanics, Cooper Energy Services. All tests were satisfactory except for three anomalies. Each of these anomalies is addressed by M. Horne. He concludes that the production Magnetrol Switch assemblies meet all of the seismic and aging requirements. The tests were done for an equivalent age of 8.55 years. A maintenance and surveillance program is in effect to follow this item.

The documentation shows that this equipment is satisfactory for use in the Byron plant, subject to the implementation of the maintenance and surveillance program.

BOP/5: New Fuel Racks

No significant issue was noted as a result of the first SQRT audit. Hence, this equipment is considered qualified.

BOP/6: Hydrogen Recombiner

The installation of the Hydrogen Recombiner Unit was found complete. An additional concrete wall structure is built around the equipment to protect it from surrounding structure or equipment missiles. Thus, this equipment qualification and installation are found satisfactory.

BOP/7: Motor Operated Globe Valves

The reports qualifying this equipment are:

- (1) "Seismic Qualification Report for 900# Globe Valves",
(1,2 AF013A-H), dated 3-18-82.
- (2) "Seismic Analysis: 4" Forged Pressure Seal Globe Valve
ASME Class 900# Carbon Steel, Nuclear Class 2", Report
No. 6633, dated 3-18-82.

Both of these reports were prepared by Velan Engineering Corporation. A horizontal g' load of 4 g and vertical load g 1.5 g (i.e., Resultant of 6.52 g) were used in the calculations.

The valve was designed according to the ASME requirements. The operator to this valve is a limitorque motor operator of type SMB-00-10. The qualification of the operator is addressed in the Limitorque Generic Report for all of their operators.

Based on the review of all related documents, this equipment is found to be qualified for the Byron site.

BOP/8: Motor Operated Gate Valve

The issue⁹ relating to the qualification of the valve-valve operator assembly excited by the sudden closing or opening of the operator was resolved based on the July 7, 1983 submittal by the applicant. However, the qualification documents for the motor operator were reviewed during the second audit. These reports were completed in a bound volume entitled, "Limitorque Valve Actuator Qualification for Nuclear Power Station Service", Report No. B0058, dated 1-11-80. This report was prepared by Limitorque Corporation and it envelopes a family of Limitorque Motor operators (SMB/SB/SBD/SMC/HBC). All test were conducted as per IEEE-382 (1972), IEEE-323(19M) and IEEE-344(1975) requirements. The test labs involved in this generic study are Aero-Nav Lab. for seismic tests, Environmental Testing Corporation and Wyle Lab for both seismic and environmental testings.

Based on this review, it is concluded that the Limitorque operator for this gate valve is qualified for Byron site.

BOP/9: Main Steam Isolation Valve and Actuator

This equipment was considered qualified as a result of the first SQRT audit.

BOP/10: Motor Operated Butterfly Valve

The qualification of the Limitorque motor operator for both environmental and seismic testing is based on the generic qualifying documents mentioned under the equipment item BOP/8. Hence, this operator is considered qualified for Byron site.

The equipment g-level used in the generic qualification is found to exceed the Marble Hill Spectra and hence, there is no need for requalifying this equipment.

Based on these, this equipment is found to be qualified for Bryon site.

BOP/11: Aux. Feedwater Pump and Drives

A test plan has been established by Southwest Research Institute to qualify the Pump Drive System (PDS) which is consisted of Pump Drive (PD), Control Cabinet (CC) and Electric Start System (ES). The test will be completed by March 1984. The report describing the test plan was reviewed at the site audit and is entitled as "Qualification Plan for the qualification of PDS Nos. 74410-74505 for application in the Commonwealth Edison Company, Byron/Braidwood Station Unit 1 and 2", by Southwest Research Institute for Stewart and Stevenson Services, dated March 1982. The results of this program will be published in eleven separate volumes addressing all environmental and seismic tests.

Reviewing the above document it is concluded that this equipment will be considered qualified provided the test results would be found satisfactory.

BOP/12: Essential Service Water Pump and Motor

This equipment was installed in mild environment at the plant site and hence, require no aging for nonmetallic components. All other issues were satisfactorily addressed in the July 7, 1983 resolutions submitted by the applicant. Based on this, this equipment is considered qualified for the Byron seismic environment.

BOP/13: Hydrogen Recombiner Control Panel

This equipment was considered qualified as a result of the first SQR audit.

BOP/14: Diesel Generator Governor

The report reviewed for qualifying this equipment is entitled: "Seismic Simulation Test Program as an EGB-50 P/LS Actuator and a VG-8L Overspeed Trip", CES-0351-49, October 9, 1978. This was prepared by Cooper Energy Services and Wyle Lab.

Based on this review this equipment is considered qualified for the seismic loading at the Byron site.

NSSS/15: Differential Pressure Transmitters

The qualification of this equipment are included in the Westinghouse Component and Materials Aging Program described in WCAP-8587, Appendix A-1 and A-2. These have been reviewed by the NRC and EG&G as part of the generic review program and were found to be acceptable.

Based on this it is concluded that this equipment for Byron site.

NSSS/16: PAM Indicators

All PAM indicators are mounted on the Main Control Board (MCB). The qualification of the MCB has been completed, which was found to be structurally rigid. Hence the TRS for the PAM indicators were found to envelope the floor response spectra which was used for qualifying this equipment. All other open issues summarized in the original BNL trip report were resolved and considered satisfactory as per July 7, 1983 resolutions submitted by the applicant.

Based on this, this equipment is considered qualified for the Byron Seismic Environment. However, the installation of these devices needs to be labeled for issues relating to human factors.

NSSS/17: Main Control Board

The qualification of this equipment has been completed and the report summarizing the analysis results is entitled as "Seismic Qualification of the Byron/Braidwood Main Control Board", Westinghouse NTD, WCAP-10393, August 1983. The analysis was conducted on a 3-D finite element model using the computer code WECAN. The fundamental frequencies of the MCB are found to be 25.7 Hz in S/S, 28.5 Hz in F/B, and 33 Hz in vertical directions. A response spectrum analysis was conducted instead of a time history method as proposed earlier.

Since the natural frequencies are close to the cut-off frequency of 33 Hz, no amplification due to the due MCB is expected for all the devices mounted on it. A good correlation between the analysis and test results has been established by Westinghouse. This was reported in a report, "Correlation of Test and Analysis of a full-size MCB Center Section", WCAP-9985, dated November 1981. The maximum stress is 31% of AISC allowable stress.

Based on the above review and explanations provided by Westinghouse Engineers, this equipment is considered to be qualified for Byron site.

NSSS/18: Control Rod Drive Mechanism

The design of this equipment is quite similar to that installed at Comanche Peak. All the open issues raised at the first SQRT audit are also identical except a few minor issues. The applicant has satisfactorily addressed all the issues in the July 7, 1983 submittals.

The design of Comanche Peak CRDM qualification has been already accepted based on all the explanations provided by Westinghouse. Issues relating to Marble Hill Spectra have been resolved during the second SQRT audit. Thus, this equipment is considered qualified for the Byron site. However, the installation of the CRDM is yet to be completed prior to fuel load.

NSSS/19: RCS Bypass and Well-Mounted RTD

All the open items relating to this equipment have been accepted as per the July 7, 1983 submittals by the applicant. All the sixteen narrow range and eight wide-range RTD's were installed at the time of second SQRT audit. The qualification has properly addressed the Marble Hill Spectra in its design documents.

Based on the above review, this equipment is considered qualified for Byron site.

NSSS/20: Valve Limit Switches

The resolutions submitted by the applicant on July 7, 1983 have demonstrated the 'worst case' plant-specific acceleration level as compared to the generic test-acceleration level. The second issue relating to the surveillance and maintenance program has been addressed as one of the generic issue.

Based on the above explanations, this equipment is considered qualified for Byron site.

NSSS/21: Motor Operated Gate Valves

The previous report of the first plant site visit states that the plant specific piping accelerations for valve 8701 B were above the applied loads that were used in analysis. It is stated that the piping levels of 2.94 g, 2.46 g, 2.36 g and 3.77 g evaluated by Eric Kropp of Piping Analysis and Design were in excess of the design levels for the valve.

Westinghouse has re-evaluated the problem. In a letter dated November 2, 1983, signed by F.J. Orehowsky, Manager Valve and CRDM Engineering, it is stated that the valves have been structurally evaluated to be capable of these higher accelerations.

The valve operator documentation was also not complete during the first visit. The qualification of the new motors is contained in a report "Equipment Qualification-Test Report Limitorque Motor Operator ---" dated July 1983 by M.J. Zegar, WCAP 8687.

The test program was carried out to demonstrate that the Limitorque Motor Operators meet their safety related requirements while subjected to environmental loads in accordance with IEEE 323-1975 and IEEE 344-1975.

Conservative load values were used in each of the environmental tests. A qualified life of five years was used, based upon the thermal aging time and temperature utilizing a conservative activation energy for the materials involved. The seismic testing levels exceeded the maximum required levels by 40%.

Based upon the successful completion of the full sequence of testing, the Limitorque Motor Operators are seismically qualified. Since qualification have been carried out for a projected period of five years, a maintenance program is required.

NSSS/22: Motor Operated Gate Valve

There were two open issues that remained after the first inspection visit. The first of these related to the need to justify the bolted bonnet design. This justification was discussed during the November 8, 1983 inspection visit and was further confirmed by a letter dated May 26, 1983. The letter was sent to the Westinghouse Corporation from the Velan Valve Corporation and was signed by S. Isbitsky, Manager, Stress Department.

It states that the stresses in the bolted bonnet joints are negligible in comparison with other loads. The statement is based upon the fact that the bonnet and body are closely piloted. Accordingly, the bolts are not subject to any transverse shear load. This reply is accepted.

The second has to do with the need for testing the valve operator. The existing SQRT form reports on the qualification of the interim motor operator. For this motor 3 endurance tests were performed at 6 g. The maximum test level for the new motors was at 7.6 g. The motor has a natural frequency in excess of 35 Hz. The maximum acceleration required is about half of the applied level. This information is contained in the Westinghouse Report WCAP-8687, Supp. 2-H01A, dated July 1983.

It is concluded that the Motor Operated Gate Valve is qualified for the Byron plant.

NSSS/23: RHR Pump and Motor Assembly

The installation of this equipment and its appertunances has been visited during the second audit. All tubes and small-bore piping were found to be properly fastened. The conduit lines were fastened to very low frequency hangers from the ceilings. However, these lines are not safety-related. All other issues were resolved as per the July 7, 1983 submittal by the applicant.

Based on this audit and installation verifications, this equipment is considered qualified for Byron site.

NSSS/24: Safety Injection Pump

The applicant has provided responses to the two open audit items.

The first item requested information to demonstrate that enough clearance was provided between the shaft and surrounding components so that the pump can function normally. This item is still open since Westinghouse is currently performing a shaft deflection analysis and the final report has not yet been submitted to the staff for review.

The second item relates to the Westinghouse Report WCAP-8230. This report has been accepted by the staff; therefore this item is considered closed.

NSSS/25: Air Operated Valve

Based on the July 7, 1983 submittal, both the open items relating to the qualification of the valve body and bend test were considered resolved. Hence, this equipment is qualified for the Byron seismic environment.

BOP/S1: DC Distribution Center

The DC Distribution Center provides related DC power to various systems. The equipment was qualified by test. The test report is Wyle Laboratory Report No. 43757-1, "Motor Control Center 1C7700", July 26, 1978.

The test was done in accordance with Seismic Test Plan 541/5566-2E3, August 11, 1977.

The test program consisted of a biaxial sine beat on random multifrequency tests and resonant search in each of two test orientations. The specimen was instrumented with accelerometers and was electrically powered, electrically loaded and monitored for operation during the test program.

The specimen experienced electrical and structural malfunctions during the test program.

The specimen also was subjected to environmental testing (Wyle Test Report 43757-2) to demonstrate that the devices will remain operational during their operational lifetime.

The environmental program included electrical aging, thermal aging, radiation exposure followed by additional thermal aging.

The seismic testing was done with the equipment mounted in accordance with the actual installation. Seismic testing followed the environmental tests.

The specimen was subjected to 40 second duration simultaneous horizontal and vertical phase incoherent random inputs consisting of frequency bandwidths spaced 1/3 octave apart over a frequency range of 1 Hz to 40 Hz. The amplitude independently adjusted until the TRS envelopes the RRS. Fifteen oscillation sine beats were superimposed on the random signal sequentially on the 40 second duration signal at frequencies of 4, 5, 8, 2.5, 3.2 and 6.3 Hz. The resulting table motion was analyzed by a spectrum analyzer at a damping value of 5% and plotted at 1/3 octave intervals.

5 OBE (1/2 SSE) tests followed by a full level SSE.

The tests were performed in each of 3 electrical conditions:

1. Specimen energized
2. Specimen de-energized
3. Specimen change of state during simulated seismic excitation.

All components maintained their operational integrity and performed satisfactorily at the end of the environmental exposure period as well as during the seismic events. The anomalies which occurred during seismic were discussed in the report by G.E., No. 81GPC001, Rev. 1, dated 1/21/83. The report concludes that the will function satisfactorily.

Based on the review, the equipment is considered qualified for the Bryon seismic environment.

NSSS/S1: Power Operated Relief Valve (PORV)

Pressurizer Power Operated Relief Valves are classified as ASME Class 1 Air Operated Control Valves (455A, 456). Two units of these are installed in the RCS loops of Unit 1 to control RCS pressure. These are required for overpressure relief to minimize challenges to safety valves and to mitigate steam generator tube rupture event. They were mounted on 3" lines at elevation of 461'-7" (455A) and 456'-7" (456) in the containment building. The ratings of these 1513 lbs. valves are 210,000 lbs./hr. of steam relief and have operators with Model No. D-100-160. Each unit was horizontally mounted to the pipe via butt welds with the stem extending vertically. Each weighs 435 lbs. and has a dimension of 47 1/2" H and 18" W. It is manufactured by Copes-Vulcan. The unit has components such as limit switch (NAMCOEA170) and solenoid valve (ASCO-FT831654) connected to the operator.

Both units were installed at such a high altitude, the SQRT team could not reach the location to audit the monitoring conditions. However, pictures taken by others showed no such problems in the as-built installation of these units.

The reports reviewed at the site are:

- (1) Air Operated Control Valves, Design Report No. 10.2.117, Rev. 2, 12/28/79. WNES No. 546-CCP-183620-XN, CVI No. 7310-95280. Prepared by Copes-Vulcan and reviewed by Westinghouse.
- (2) Evaluation of Byron/Braidwood PORV's to Operate Post-SSE, MED-PVE-1279, Rev. 1, 11/4/83. Prepared by Westinghouse.
- (3) PORV OBE Seismic Evaluation for Bryon, MED-PVE-1929, 11/4/83. Prepared by Westinghouse.

- (4) WCAP-8687, EQDP HE-3, NAMCO Externally Mounted Valve Limit Switches, Rev. 1, 7/81. Prepared by Westinghouse.
- (5) Safety Related Solenoid Valves, WCAP 8667, EQDP HE-2, Rev. 2, 6/81. Prepared by Westinghouse.

The last two reports qualify the ASCO Solenoid Valve and NAMCO limit switches as required in IEEE-323-1974 and IEEE-344-1975. These components were qualified by tests. Both these components have natural frequencies much larger than 35 Hz and hence were considered as rigid. Each was subjected to 5 OBE and 1 SSE, and the components responded satisfactory performances.

The valve operator was tested for a static bend test with a g-load of 6.7 g for operability. The deflections noted out of this test assured the operator stem to operate under seismic loads. However, it has been noted that the intensity of one SSE load is of the order of 9.09 g which exceeds the tested rating of 6.7 g. Hence, the bend test results can no longer be used to assume a safe operation of the valve under the Byron seismic environment.

The valve was first qualified by the vendor for a generic load of 2.1 g in each direction. Since the plant specific g-level is higher than the generic level, Westinghouse has performed supplementary calculations to qualify the valve for the Byron site. The stress conditions at the Yoke mounting bolts are very high but below the allowable limits.

Based on the above review, the equipment is considered qualified provided the following open items are satisfactorily resolved.

- (1) An explanation of the load due to relief thrust would be helpful in understanding the hydrodynamic loads as mentioned in the SQRT forms.
- (2) The static bend test g-load level is below the plant specific SSE level. The actual deflection during the test could be extrapolated for the new load in order to verify whether there would be any interferences between the operator stem and the valve body during the SSE event.

(3) The non-metallic diaphragm material should be qualified for aging. Otherwise the qualified life for this component should be established for proper maintenance and surveillance program.

(4) Complete the SQRT as discussed at the site audit.

Byron Nuclear Power Station - Unit 1
Addendum SQR7 Audit Report

NSSS/21 and 22: Motor Operated Gate Valve

The applicant has corrected the SQR7 forms after upgrading the valve operator. The qualifying reports were reviewed at the site audit and found acceptable.

NSSS/24: Safety Injection Pump

Westinghouse Report Supp. 1 to K-363, K-386, Rev. 3, dated 6/24/83 was reviewed in response to Open Item. This report shows that there is enough clearance between the shaft and the surrounding components so that the pump will function normally.

The loads of 2.1 g in all directions used in the report are conservative. The actual plant specific loading is 0.26 g N-S, 0.280 E-W and 0.6 g vertical. The deflection analysis, carried out by a finite element model, shows a calculated value of 0.0044 inches as compared to an allowable of 0.005. A translation of a Russian paper was made available for review. The paper justifies the value of the wear ring stiffness that is used in the calculation. The clearance is therefore all right and the equipment is considered qualified.

NSSS/S1: Power Operated Relief Valve

There were four open issues raised at the site audit relating to this equipment.

The thrust load due to the pressure relief by this valve has been included in the hydrodynamic loads. These loads were considered in the piping analysis from which the nozzle loads and the valve accelerations were obtained. The valve was then qualified for these loading conditions.

Based on the static bend test deflection, the operator is found to be able to perform its functional duty even at a large SSE g-level. The extrapolated deflection is still found to be below the allowable deflection limit of 0.1112 inches.

The diaphragm was made of Buna-N material. This material has been evaluated by Westinghouse as part of the Westinghouse Corporate Thermal Radiation Materials Application Data Manual and was found satisfactory.

Based on the above responses by the applicant, this equipment is considered qualified for Byron site.