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TMI Program Office
Attn: Dr. W. D. Travers
Acting Program Director
US Nuclear Regulatory Commission
c/o Three Mile Island Nuclear Station
Middletown, PA 17057

Dear Dr. Travers:

Three Mile Island Nuclear Station, Unit 2 (TMI-2)
Operating License No. DPR-73
Docket No. 50-320
Resolution of Quality Assurance Issues
Relating to the Defueling Canisters

Your letter dated October 17, 1985, provided comments on GPU Nuclear letter 4410-85-L-0202 dated October 10, 1985, which described the actions taken to verify that the first four filter canisters, fabricated by NES, were built in compliance with the design specifications. Attachment 1 provides our response to your comments with the exception of Comment 8 which addresses the cement filler material in the fuel canisters. The response to this comment, which is not a prerequisite to acceptance of the first four filter canisters, will be submitted upon completion of GPU Nuclear's evaluation of this issue. Attachments 2 through 11 contain the applicable canister-related documents that you requested.

Additionally, your letter requested that GPU Nuclear explain our program for ensuring that the design specifications are met for the additional canisters to be fabricated by NES Manufacturing as well as those canisters fabricated by other vendors, i.e., the Joseph Oat Corporation and Babcock and Wilcox (B&W).

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Specifically, you requested that GPU Nuclear explain how this program differs in scope from the program for the first four filter canisters. GPU Nuclear letter 4410-85-L-0206 dated October 23, 1985, described the above program with specific emphasis on the actions implemented at the other canister vendors as a result of the deficiencies identified during NES fabrication of the first four filter canisters.

In addition, please be advised that based on new information just received by us, we are currently evaluating certain UT measurements conducted by NES Manufacturing of these four canisters. We will advise you of the results of this evaluation as more information becomes available.

Sincerely,

F. R. Standerfer
Vice President/Director, TMI-2

FRS/RDW/eml

Attachments

LIST OF ATTACHMENTS

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NRC COMMENT 1

Describe the program controls implemented to assure proper catalyst loading during canister fabrication at NES Manufacturing. Include the following aspects:

a. What assurance was obtained that the catalyst received from AECL and Englehard met the design specifications. If CofC's or CMTR's were included, submit these for our review.

b. What receipt inspection was performed by Bechtel and/or NES, and how was the material stored, handled, and controlled in bulk form.

c. How was the catalyst transferred from bulk form to the individual quantities for loading into the lower head cartridges and the upper cartridges for all types of canisters. How were the individual packages labeled and controlled, including maintaining traceability to individual lot numbers.

d. During weighing operations what inspection/verification of weights was performed by NES, what Quality Control witnessing was performed by NES, and how was it documented. What weight verification was required to be performed by the Bechtel Supplier Quality Representative (SQR) and what verification was actually performed by the SQR.

e. What verification of catalyst loading was performed prior to installing the retaining screen.

f. What was your basis for selecting the frequency of verification by the SQR and what was your justification for not requiring 100 percent Quality Control verification by the fabricator.

GPU NUCLEAR RESPONSE

The recombiner catalysts were purchased by product trademark from Atomic Energy of Canada Limited (AECL) and Englehard Industries Divisions. Both AECL and Englehard are required by the Bechtel Purchase Order to provide a verification that the catalyst materials are provided in accordance with the specified technical requirements and that they are identical to the materials tested at Rockwell Hanford Operations. From a quality and safety concern, material traceability in subsequent fabrication processes is not required since the chemical nature of the catalyst is certified.

The AECL and Englehard catalysts were received at NES with the required Certificates of Conformance (C of C's), which are provided in Attachment 2, and the test reports. The material was receipt inspected by NES for the general condition of the shipping container and catalyst and included a review of the above documentation. This receipt inspection was witnessed by the Bechtel SQR. The material was stored in the original shipping containers (cardboard lined with plastic sheet) in a clean, dry storage area.

The weighing of the catalyst was performed by NES Manufacturing personnel in the storage area. Wearing plastic gloves, personnel weighed out 5 grams of AECL catalyst into a plastic bag and 20 grams of Englehard catalyst into another plastic bag. These two bags were then bound together with a twist tie to form a catalyst assembly. The weighing operation was controlled by the manufacturing sign-off on the traveler. NES Quality Assurance verified this operation and signed the travelers for approximately 25% of the weighing operations. There is no inspection plan requirement for the Bechtel SQR to verify the weighing operations. However, during random in-process inspections, the Bechtel SQR witnessed approximately 20% of the weighing operations and signed the travelers. The catalyst assemblies were then returned to the original shipping container to await loading.

NES Quality Assurance authorized the withdrawal of the catalyst assemblies necessary for loading. The lower heads for each canister type are identical and have four catalyst bed housings. One catalyst assembly was poured into each of the four catalyst bed housings. The upper heads of the fuel canister have one catalyst bed housing. Four catalyst assemblies were poured into the fuel canister upper head catalyst bed housing. The upper heads of the knockout and filter canisters each have two catalyst bed housings. Two catalyst assemblies were poured into each of the catalyst bed housings in the upper heads of the knockout and filter cansiters. The loading operation was controlled by the manufacturing and Quality Assurance sign-off of the traveler.

NES Quality Assurance verified 100% of the loading operations. The Bechtel SQR visually verified the presence of both types catalyst in 100% of bottom heads and upper heads prior to screen installation. A 20% minimum verification by the Bechtel SQR is required by the inspection plan.

The fabrication of all canisters is to be performed under the Quality Assurance program requirements stated in ANSI N45.2 which supports 10 CFR 50 Appendix B. The specification, which governs the fabrication process, identifies clearly those program elements necessary for the Quality Assurance fabrication activities which are described in Appendix A of Specification 15737-2-M-101A (Q) (Attachment 3). Seventeen (17) of the standard eighteen (18) elements are indicated by GPU Nuclear as being applicable to canisters. Design control was not required since this is a "fabrication only" contract.

An audit of the NES Quality Assurance Program conducted prior to the start of fabrication has shown that Quality Control coverage prevails throughout the entire fabrication effort for each step, i.e., 100%. An independent inspector stamps and signs each shop traveler as it is completed. This system fully meets the requirements of ANSI N45.2.

Concerning the SQR surveillance, the level of coverage is selected to ensure sufficient information is available to the buyer to judge that the fabricator complies with procedures. SQR coverage is not meant to replace the supplier's responsibility. It is noteworthy that GPU Nuclear reviewed the traveler for catalyst installation and verified that the SQR performed a 100% witnessing of catalyst installation.

NRC COMMENT 2

In light of recent discussions on the apparent discoloration of the catalyst screens and pellets seen on one (1) in-process lower head, what actions have been or will be taken to determine if there is any potential for catalyst degradation from heat of welding.

GPU NUCLEAR RESPONSE

The attachment of stainless steel screens to the stainless steel catalyst bed housings is usually accomplished by heli-arc welding. If local catalyst damage does occur as a result of heating, the color of the Englehard catalyst would change from dark grey to very light grey. The color of the silicone-coated AECL catalyst would change from dark grey to black. Vapor from the damaged catalyst would not damage the adjacent catalyst.

To allow for catalyst damage, freezing conditions, and unforeseen conditions, the catalyst beds have a number of significant, built-in margins of safety which are documented in GEND-051, "Evaluation of Special Safety Issues Associated With Handling the Three Mile Island Unit 2 Core Debris", and are briefly discussed below.

Testing of the catalyst was conducted using gas generation rates of 0.2 liter/hr of hydrogen and 0.1 liter/hr of oxygen. As stated in the Defueling Canister Technical Evaluation Report (TER) submitted by GPU Nuclear letter 4410-85-L-0183 dated September 10, 1985, the calculated probable maximum hydrogen plus oxygen generation rate is 0.11 liters/hr. This results in a margin of safety of 2.7. During the above described testing, the mixed bed catalyst maintained the oxygen concentration to below 0.6% and the hydrogen concentration to below 1.2%. As the lower flammability limits are 5% for oxygen and 4% for hydrogen, this results in margins of safety of 8.3 for oxygen and 3.3 for hydrogen. Thus, the resulting net margin of safety is greater than a factor of 9 (i.e., there is 9 times more catalyst than requried).

GPU Nuclear has concluded that though limited catalyst damage was observed, the built-in margin of safety is sufficient to ensure recombination of the hydrogen and oxygen generated in the defueling canisters. Therefore, based on the above, GPU Nuclear believes that no further actions are required to determine the potential for catalyst degradation from heat of welding.

NRC COMMENT 3

Submit copies of the reports of all Quality Assurance surveillance and audits performed at NES. Additionally, provide all existing and future reports, as available, of audits and surveillance performed at all other canister fabricators.

GPU NUCLEAR RESPONSE

Attachment 4 provides the surveillance reports of the eleven (11) surveillances performed at NES. Attachment 5 provides a copy of the joint GPU Nuclear/Bechtel Quality Assurance Audit of NES conducted on April 23-24, 1985.

A copy of the initial surveillance/audit of the Joseph Oat Corporation, Camden, NJ, conducted on July 10-11, 1985, is provided in Attachment 6. A copy of the initial surveillance/audit of B&W, Lynchburg, VA, conducted on August 5-7, 1985, is provided in Attachment 7.

Audits of canister fabrication are scheduled as follows:

a. Joseph Oat Corporation, Camden, NJ - October 23-25, 1985

b. B&W Lynchburg, VA - November 5-7, 1985

GPU Nuclear maintains records of audits and surveillances performed at vendor facilities. As these records are available for NRC inspection, GPU Nuclear believes that an open-ended commitment to submit all future reports is not necessary; in order for the NRC to ensure that canisters manufactured by these vendors are acceptable; however, we will continue to respond to requests for specific documents.

NRC COMMENT 4

What testing has been performed to demonstrate the capability of the recombiner catalyst with all expected chemical contaminants, including the hydraulic fluids used with the defueling tools and the core boring equipment.

GPU NUCLEAR RESPONSE

GEND-051 describes the testing which has been performed to demonstrate the compatibility of the recombiner catalyst with all expected chemical contaminants exclusive of hydraulic fluids. Supplemental testing is being performed to demonstrate the compatibility of the recombiner catalyst with the hydraulic fluids which may be used in the defueling tools. These hydraulic fluids are either a 25/75% volume mixture of Borate Ester/UCON WS-34 hydraulic fluid or borated UCON WS-34 hydraulic fluid. The hydraulic fluid to be used in the core bore assembly is Houghto-Safe 620. Attachment 8 describes the testing to be performed.

Currently, only one test has been completed. This test and its results are described below. The results of further testing will be forwarded for your information upon their availability.

The testing consisted of briefly rinsing 101 grams of mixed bed catalyst and submerging it in water with a 2% solution of a 25/75% by volume of Borate Ester/UCON WS-34 hydraulic fluid. The water included appropriate quantities of boric acid and sodium hydroxide to simulate the water in the reactor coolant system. The catalyst was then placed in the test chamber under dripping wet conditions and covered with two (2) atmospheres of Argon gas. Next, 0.3 liters/hr of stoichometric hydrogen and oxygen gases were added to the test chamber; the concentration of oxygen in the cover gas built up to a 0.6% peak in five (5) hours and decreased thereafter. This catalyst performance is essentially identical to that which was reported in GEND-051. It therefore appears that this particular mix of hydraulic fluid has the same effect as water on catalyst performance.

Although not directly related to the above NRC comment, additional evaluations have been made to verify the compatibility of the fluids that may be used during defueling and core bore. The fluids that may be used, namely borated Ester, UCON WS-34, and Houghto-Safe 620, have been tested for compatibility to the RCS, SDS, and EPICOR II by GPU Nuclear and have been deemed acceptable. The miscibility of these fluids with RCS water has also been confirmed. GPU Nuclear has also verified the homogeneity of the borated Ester and UNCON WS-34 mixture and the borated UCON WS-34 mixture as well as the absence of boron precipitation from these mixtures.

NRC COMMENT 5

Describe the program controls implemented to assure proper B_4C loading during canister fabrication at NES Manufacturing. Including the following aspects:

a. What assurance was obtained that the poison material received from the supplier met the design specifications. If CofC's or CMTR's were included, submit these for our review.

b. Bechtel Specification 15737-2-M-101A, Section 5.3.1, requires the canister vendor to perform a prototype test of the manufacturing process which demonstrates that the minimum B_{10} content requirements are met. Explain how this specification was satisfied and submit the related documentation.

c. What receipt inspection was performed by Bechtel and/or NES of the B_4C material, and how was the material stored, handled, and controlled.

d. Describe the program for transferring the poison material from bulk supply to the individual poison tubes. In particular, how was the quantity of the material installed in the tube controlled and verified, what independent verification was performed, and how was traceability to individual lots maintained.

GPU NUCLEAR RESPONSE

Due to the importance of neutron poison in the canister safety analyses, it has been a requirement that the fabricator test the manufacturing process for B_4C materials. This was accomplished for pellet fabrication through testing of the first production scale lot of poison pellets. Isotopic and chemical tests were performed. The results of these tests demonstrate that the minimum B-10 isotopic concentrations exceed the requirements of the specification referenced in the above NRC comment.

Additionally, periodic samples are analyzed throughout the fabrication process to demonstrate consistency to a 95/95% statistical confidence level for each every pellet lot. This analysis is documented in vendor documents 15737-2-M-101A-25-01 and 23-03 (Attachments 9 and 10, respectively).

The poison material was received at NES with the required C of C's (Attachment 11) and the vendor inspection and test reports. The material was receipt inspected for general condition of shipping containers, dimensional inspection of a sample of poison material, and review of documentation. The receipt inspection was witnessed by the Bechtel SQR. The material was stored in the original shipping containers (cardboard lined with plastic sheet) in a dry, inside storage area.

The poison pellet was segregated in the packages to correspond to a single tube. The pellet manufacturer does this by placing pellets in a tray which is benchmarked to the minimum poison tube inside volume allowed per canister design. The pellet manufacturer then certifies, using the required Quality Assurance procedures, that each individual tray meets or exceeds the minimum quality of B-10. Each tray is then packaged for shipment to the canister fabricator and marked traceable to pellet lot and powder lot. This is done to ensure minimum B-10 content is achieved.

Since minimum B-10 content is ensured to a 95/95% statistical confidence level for every tray, traceability to a particular canister is not needed. Tray numbers are marked (etched) on the outside of each poison tube by NES; this process exceeds the requirements of the specification.

The loading of the poison material into the tubes was performed by NES Manufacturing personnel in the storage area. The poison, in the form of 2" slugs was received from the vendor in trays. Each tray contained the required poison for one tube. NES Quality Assurance would authorize the withdrawal of a poison tray and the material was spot checked by NES for general condition and dimensions. After the tube was cleaned and inspected, the slugs were loaded into the tube and the tube capped. The above process is documented in vendor document 15737-2-M-101A-31-02 (Attachment 12). The loading operation and inspections were verified 100% by NES Quality Assurance and travelers were signed off. The SQR witnessed a minimum of 20% of the operations and signed off the travelers as appropriate.

NRC COMMENT 6

You have stated that there is considerably more conservatism in the catalyst bed design than that stated in the Technical Evaluation Report. Provide a description of the design conservatism and the calculations and experimental data to support these statements.

GPU NUCLEAR RESPONSE

See the response to NRC Comment 2.

NRC COMMENT 7

Iron oxide was observed on the canister lower heads, presumably from forming these heads on a carbon steel die. Provide a justification for your conclusion that carbon steel impregnation of the stainless steel heads will not affect the acceptability of the shell to head welds and the long term structural and corrosion properties of the canisters. Will any action be taken to remove this iron oxide.

GPU NUCLEAR RESPONSE

Iron oxide was observed on the canister lower heads. This has been shown to be a surface phenomenon, probably associated with the forming process. The demonstration that this is a surface phenomenon was conducted at the Bechtel Materials Testing Laboratory in San Francisco, CA. A reject head, with iron oxide on both the inner and outer surfaces in quantities significantly greater than those on the canisters, was sent to this laboratory from the canister vendor's fabrication shop.

The Materials Testing Laboratory provided the following information:

"We have examined the canister head shipped to us by NES. Both sides of the head were streaked with red rust. The convex (inner) side had heavier concentrations.

The rust could be removed by light mechanical polishing. We used emery paper, but brushing with stainless steel wire brushes could accomplish the same purpose. After the rust stains were removed, the stainless steel surfaces were tested with a copper sulfate solution that will reveal iron contamination (see ASTM A380). No iron contamination was observed on the cleaned surfaces.

On the basis of our examination we believe that the rust stains are the result of mild iron contamination of the stainless steel surfaces. This contamination would come from steel dyes used for forming the head or from the airborne metal dust that would be expected in a fabrication shop. The rusting patterns are the type that one would expect from such casual contamination.

The rusting is not an indication of any corrosion deficiency of the stainless steel. The iron contamination of the stainless steel surfaces will not affect its ability to resist corrosion in the water environments in a fuel pool. Furthermore, it will not diminish its ability to withstand any reactor coolant water remaining in the fuel".

GPU Nuclear concludes, therefore, that the presence of the small quantities of surface contamination observed will have no deleterious effect on canister performance. However, as an added measure, the fabrication procedures at all canister fabrication shops have been revised to require power brushing, using a stainless steel brush, to remove all visible rust.

NRC COMMENT 9

Attachment 6 to your letter 4410-85-L-0202 dated October 10, 1985, is the completed filter canister checklist package. It is marked as Revision 1. What revisions were made to the checklists after their completion? If additional revisions are to be made, submit the completed final revisions with an explanation of the revision for our review.

GPU NUCLEAR RESPONSE

Revision 2 was issued for configuration control purposes to include previously omitted verification items and to incorporate GPU Nuclear comments which were primarily directed at improving the clarity and understandability of the checklists. All pages of the checklist packages are identified as Revision 2.

Also revised were checklist pages M-6B page 1, M-7 page 1, M-16 pages 1 and 2, F-3 page 1, F-3 page 2, F-4 page 2, F-8 page 1, and F-8 page 2.

A revised checklist is provided in Attachment 13. Note that revisions are identified with a revision bar, and that this checklist covers all four (4) of the filter canisters under consideration.

Currently, GPU Nuclear does not anticipate any further changes to this checklist. However, in the event of future revisions, they shall be submitted for your information along with an explanation of the revisions.

NRC COMMENT 10

Attachment 1 to the completed checklist states in section 4 that imposition of ANSI N45.2 was not necessary since CMTR's/CofC's were requested. Did you verify that the suppliers held a current ASME Quality System Certificate? If not, justify how a CMTR/CofC can be considered valid if not supported by an approved Quality Assurance Program.

GPU NUCLEAR RESPONSE

Filter Canister Checklist Attachment 1, Section 4 provides a brief and general explanation of instances where NES did not impose the ANSI N45.2 Quality Assurance program requirements on material suppliers. The Bechtel Review Team independently evaluated the need for imposing such requirements on the supplier of the specific material mentioned in the checklist and concurred with NES's decision not to impose such requirements. Wherever Section 4 is referenced in the checklists, the review team evaluated, on an item by item basis, the acceptability of the supplied material solely on the basis of either CMTR's or C of C's required by NES.

In judging the need for imposition of Quality Assurance program requirements, the Review Team considered the complexity, uniqueness, degree of standardization, and applicability of any special technical or special process requirements. Note that the materials referenced in Attachment 1, Section 4 are not specifically manufactured for nuclear industry use only. They are standard commercially available products, generally manufactured in accordance with specific Standard requirements, e.g., ASTM. These products generally have been and continue to be procured by the nuclear industry solely on the basis of CMTRs/C of C's, without the imposition of unique nuclear industry Quality Assurance program requirements being imposed on suppliers of such products. As for current ASME Quality System Certification, note that the canisters are ASME Code Section VIII Vessels and ASME Code Section VIII does not specifically mention or require an ASME Quality System Certificate, as is required by ASME Code Section III.

ASME Code Section VIII only requires that "the manufacturers shall have a system of receiving control which will ensure that the material received is properly identified and has documentation including required Certificates of Conformance or material test reports to satisfy code requirements as ordered".

NRC COMMENT 11

Explain in further detail how the upper heads are traceable to their heat numbers. At what point in the process were the heat numbers removed? Justify how this meets the ASME Code requirements on material traceability.

GPU NUCLEAR RESPONSE

The material for the upper heads was received by NES as round plate slugs. Each slug was stamped with a heat number traceable to one of the three CMTRs also received. The material was inspected for dimensions and heat number and the CMTRs reviewed to the material requirements. The heat number was maintained by stamping, throughout the machining operation. When the heads were welded to the shell, the heat number, which was stamped on the underside of the head, was no longer accessible. Although unique traceability to a heat number was not maintained, all heads were verified to be of the same material specification, grade and type; therefore, code required traceability was maintained. This traceability was verified by NES Quality Assurance, the Bechtel SQR and the Code Inspector, as evidenced by his acceptance of the code data report for the canisters.