DUKE ENERGY

Steven D. Capps
Vice President
McGuire Nuclear Station

Duke Energy
MG01VP I 12700 Hagers Ferry Road
Huntersville, NC 27078

o: 980.875.4805
f:: 980.875.4809

Steven.Capps@duke-energy.com

10 CFR 50.4

February 27, 2014
Serial: MNS-14-023

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

Duke Energy Carolinas, LLC (Duke Energy)
McGuire Nuclear Station (MNS), Units 1 and 2
Docket Numbers 50-369, 50-370
Renewed License Numbers NPF-9 and NPF-17

Subject: Second Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051)

References:

1. NRC Order Number EA-12-051, Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation, dated March 12, 2012, Agencywide Documents Access and Management System (ADAMS) No. ML12054A679
2. NRC Interim Staff Guidance JLD-ISG-2012-03, Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation, Revision 0, dated August 29, 2012, ADAMS No. ML12221A339
3. NEI 12-02, Industry Guidance for Compliance with NRC Order EA-12-051, "To Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation", Revision 1, dated August 2012, ADAMS No. ML12240A307
4. Duke Energy Letter, Duke Energy Carolinas, LLC, (Duke Energy) Initial Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051), dated October 29, 2012, ADAMS No. ML12307A022
5. Duke Energy Letter, Duke Energy Carolinas, LLC, (Duke Energy) Overall Integrated Plans in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051), dated February 28, 2013, ADAMS No. ML13086A095
6. Duke Energy Letter, Duke Energy Carolinas, LLC, (Duke Energy), First Six-month Status Reports in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051), Dated August 26, 2013, ADAMS No. ML13242A009

A001
NRR

7. McGuire Nuclear Station, Units 1 and 2 -Interim Staff Evaluation and Request for Additional Information Regarding the Overall Integrated Plan for Implementation of Order EA-12-051, Reliable Spent Fuel Pool Instrumentation, dated October 28, 2013, ADAMS Accession No. ML13281A791.
8. McGuire Nuclear Station, Units 1 and 2 – Correction Letter to Interim Staff Evaluation and Request for Additional Information Regarding the Overall Integrated Plan for Implementation of Order EA-12-051, Reliable Spent Fuel Pool Instrumentation (TAC NOS. MF1062 and MF1063), dated December 20, 2013, ADAMS Accession No. ML13353A142

On March 12, 2012, the Nuclear Regulatory Commission (NRC) issued Order EA-12-051 (i.e., Reference 1) to Duke Energy. Reference 1 was immediately effective and directs Duke Energy to have a reliable indication of water level in associated spent fuel storage pools. Specific requirements are outlined in Attachment 2 of Reference 1.

Reference 1 required submission of an initial status report 60 days following issuance of the final interim staff guidance (i.e., Reference 2) and an overall integrated plan (OIP) pursuant to Section IV, Condition C. Reference 2 endorses industry guidance document NEI 12-02, Revision 1 (i.e., Reference 3) with clarifications and exceptions identified in Reference 2. Reference 4 provided the Duke Energy initial status report regarding Spent Fuel Pool instrumentation. Reference 5 provided the Duke Energy OIP.

Reference 1 required submission of a status report at six-month intervals following submittal of the OIP. Reference 3 provides direction regarding the content of the status reports. Reference 6 provided the first six-month status report for MNS. Enclosure 1 provides the second six-month status report pursuant to Section IV, Condition C.2, of Reference 1. Enclosure 1 delineates progress made in implementing the requirements of Reference 1 including an update of milestone accomplishments since the last status report, any changes to the compliance method, schedule, or need for relief and the basis, if any.

By letter dated October 28, 2013 (Reference 7), the NRC staff provided an Interim Staff Evaluation (ISE) to MNS which included a Request for Additional Information (RAI). In accordance with Reference 7, NRC staff indicated that a response to the RAI be provided in the next six-month update for those questions where the information is available and all responses shall be provided by March 31, 2014. MNS response to the RAI is provided in Enclosure 2.

This letter contains no new Regulatory Commitments and no revision to existing Regulatory Commitments.

Should you have any questions regarding this submittal, please contact Jeff Robertson, at 980-875-4499.

I declare under penalty of perjury that the foregoing is true and correct. Executed on February 27, 2014.

Sincerely,

Steven D Capps

Enclosures:

1. Second Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051).
2. McGuire Nuclear Station Response to Spent Fuel Pool Instrumentation Interim Staff Evaluation Request for Additional Information Regarding Overall Integrated Plan for Implementation of Order EA-12-051.

xc:

V.M. McCree, Region II Administrator
U.S. Nuclear Regulatory Commission
Marquis One Tower
245 Peachtree Center Avenue NE, Suite 1200
Atlanta, Georgia 30303-1257

J. C. Paige, Project Manager (CNS & MNS)
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Mail Stop 8 G9A
Rockville, MD 20852-2738

J. Zeiler
NRC Senior Resident Inspector
McGuire Nuclear Station

Justin Folkwein
American Nuclear Insurers
95 Glastonbury Blvd., Suite 300
Glastonbury, CT 06033-4453

ENCLOSURE 1

Second Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051).

Second Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051).

1 Introduction

As documented in Reference 2 of this Enclosure, McGuire Nuclear Station (MNS) developed an Overall Integrated Plan (OIP) describing how compliance with the requirements of NRC Order EA-12-051 (i.e., Reference 1 of this Enclosure) would be achieved. The first six-month update was provided to the NRC per Reference 3. This enclosure provides an update of milestone accomplishments since submittal of the first six-month update, including any changes to the compliance method, schedule, or need for relief/relaxation and the basis.

2 Milestone Accomplishments

The Spent Fuel Pool Instrumentation (SFPI) detailed design for MNS Units 1 and 2 was completed during this update period.

Vendor testing of the SFPI for MNS Units 1 and 2 was completed during this update period. This testing indicated the SFPI will provide reliable indication of Spent Fuel Pool level over a level range equal to or greater than required by NRC Order EA-12-051.

No additional milestones were completed during the update period.

3 Milestone Schedule Status

There are no changes to the schedule as reported in Reference 2.

4 Changes to Compliance Method

No changes to the method of compliance were made during the update period.

5 Need for Relief/Relaxation and Basis for the Relief/Relaxation

MNS expects to comply with the order implementation date and no relief/relaxation is required at this time.

6 Open Items from Overall Integrated Plan and Interim Staff Evaluation

As documented in References 4 and 5, the Interim Staff Evaluation (ISE) received on October 28, 2013 included a Request for Additional Information (RAI). Enclosure 2 provides a response to the RAI.

7 Potential Interim Staff Evaluation Impacts

Pending resolution of the RAI responses in Enclosure 2, there are no potential impacts to the Interim Staff Evaluation identified at this time.

8 References

The following references support the updates to the OIP described in this Enclosure.

1. NRC Order Number EA-12-051, Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation, dated March 12, 2012, Agency wide Documents Access and Management System (ADAMS) No. ML12054A679
2. Duke Energy Letter, Duke Energy Carolinas, LLC, (Duke Energy) Overall Integrated Plans in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051), dated February 28, 2013, ADAMS Accession No. ML13086A095
3. Duke Energy Letter, Duke Energy Carolinas, LLC, (Duke Energy), First Six-month Status Reports in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051), Dated August 26, 2013, ADAMS Accession No. ML13242A009
4. McGuire Nuclear Station, Units 1 and 2 – Interim Staff Evaluation and Request for Additional Information Regarding the Overall Integrated Plan for Implementation of Order EA-12-051, Reliable Spent Fuel Pool Instrumentation (TAC NOS. MF1062 and MF1063), dated October 28, 2013, ADAMS Accession No. ML13281A791.
5. McGuire Nuclear Station, Units 1 and 2 – Correction Letter to Interim Staff Evaluation and Request for Additional Information Regarding the Overall Integrated Plan for Implementation of Order EA-12-051, Reliable Spent Fuel Pool Instrumentation (TAC NOS. MF1062 and MF1063), dated December 20, 2013, ADAMS Accession No. ML13353A142.

ENCLOSURE 2

McGuire Nuclear Station Response to Spent Fuel Pool Instrumentation Interim Staff Evaluation Request for Additional Information Regarding Overall Integrated Plan for Implementation of Order EA-12-051.

INTERIM STAFF EVALUATION AND REQUEST FOR ADDITIONAL INFORMATION

BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO THE OVERALL INTEGRATED PLAN IN RESPONSE TO

ORDER EA-12-051, RELIABLE SPENT FUEL POOL INSTRUMENTATION

DUKE ENERGY CAROLINAS, LLC

MCGUIRE NUCLEAR STATION, UNITS 1 AND 2

DOCKET NOS. 50-369 AND 50-370

1.0 INTRODUCTION

On March 12, 2012, the U.S. Nuclear Regulatory Commission (NRC) issued Order EA-12-051, "Issuance of Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation" (Agency wide Documents Access and Management System (ADAMS) Accession No. ML12054A679), to all power reactor licensees and holders of construction permits in active or deferred status. This order requires, in part, that all operating reactor sites have a reliable means of remotely monitoring wide-range Spent Fuel Pool (SFP) levels to support effective prioritization of event mitigation and recovery actions in the event of a beyond-design-basis (BDB) external event. The order required all holders of operating licenses issued under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," to submit to the NRC an Overall Integrated Plan (OIP) by February 28, 2013.

By letter dated February 28, 2013 (ADAMS Accession No. ML13086A095), Duke Energy Carolinas, LLC (the licensee) provided the OIP for McGuire Nuclear Station (MNS), Units 1 and 2, describing how it will achieve compliance with Attachment 2 of Order EA-12-51 by fall 2014 for Unit 1 and fall 2015 for Unit 2. By letter dated June 13, 2013 (ADAMS Accession No. ML13157A097), the NRC staff sent a request for additional information (RAI) to the licensee. The licensee provided supplemental information by letters dated July 11, 2013 (ADAMS Accession No. ML13197A409) and August 26, 2013 (ADAMS Accession No. ML13242A009).

2.0 REGULATORY EVALUATION

Order EA-12-051 requires all holders of operating licenses issued under 10 CFR Part 50, notwithstanding the provisions of any Commission regulation or license to the contrary, to comply with the requirements described in Attachment 2 to this Order except to the extent that a more stringent requirement is set forth in the license. Licensees shall promptly start implementation of the requirements in Attachment 2 to the order and shall complete full implementation no later than two refueling cycles after submittal of the OIP or December 31, 2016, whichever comes first.

Order EA-12-051 required the licensee, by February 28, 2013, to submit to the Commission an OIP, including a description of how compliance with the requirements described in Attachment 2 of the Order will be achieved.

Attachment 2 of Order EA-12-051 requires the license to have a reliable indication of the water level in associated spent fuel storage pools capable of supporting identification of the following pool water level conditions by trained personnel: (1) level that is adequate to support operation of the normal fuel pool cooling system, (2) level that is adequate to provide substantial radiation shielding for a person standing on the SFP operating deck, and (3) level where fuel remains covered and actions to implement make-up water addition should no longer be deferred.

Attachment 2 of Order EA-12-051, states that the SFP level instrumentation shall include the following design features:

1.1 Instruments: The instrumentation shall consist of a permanent, fixed primary instrument channel and a backup instrument channel. The backup instrument channel may be fixed or portable. Portable instruments shall have capabilities that enhance the ability of trained personnel to monitor spent fuel pool water level under conditions that restrict direct personnel access to the pool, such as partial structural damage, high radiation levels, or heat and humidity from a boiling pool.

1.2 Arrangement: The spent fuel pool level instrument channels shall be arranged in a manner that provides reasonable protection of the level indication function against missiles that may result from damage to the structure over the spent fuel pool. This protection may be provided by locating the primary instrument channel and fixed portions of the backup instrument channel, if applicable, to maintain instrument channel separation within the spent fuel pool area, and to utilize inherent shielding from missiles provided by existing recesses and corners in the spent fuel pool structure.

1.3 Mounting: Installed instrument channel equipment within the spent fuel pool shall be mounted to retain its design configuration during and following the maximum seismic ground motion considered in the design of the spent fuel pool structure.

1.4 Qualification: The primary and backup instrument channels shall be reliable at temperature, humidity, and radiation levels consistent with the spent fuel pool water at saturation conditions for an extended period. This reliability shall be established through use of an augmented quality assurance process (e.g., a process similar to that applied to the site fire protection program).

1.5 Independence: The primary instrument channel shall be independent of the backup instrument channel.

1.6 Power supplies: Permanently installed instrumentation channels shall each be powered by a separate power supply. Permanently installed and portable instrumentation channels shall provide for power connections from sources independent of the plant [alternating current (ac)] and [direct current (dc)] power distribution systems, such as portable generators or replaceable batteries. Onsite generators used as an alternate power source and replaceable batteries used for instrument channel power shall have sufficient capacity to maintain the level indication function until offsite resource availability is reasonably assured.

1.7 Accuracy: The instrument channels shall maintain their designed accuracy following a power interruption or change in power source without recalibration.

1.8 Testing: The instrument channel design shall provide for routine testing and calibration.

1.9 Display: Trained personnel shall be able to monitor the spent fuel pool water level from the control room, alternate shutdown panel, or other appropriate and accessible location. The display shall provide on- demand or continuous indication of spent fuel pool water level.

Attachment 2 of Order EA-12-051, states that the SFP instrumentation shall be maintained available and reliable through appropriate development and implementation of the following programs:

2.1 Training: Personnel shall be trained in the use and the provision of alternate power to the primary and backup instrument channels.

2.2 Procedures: Procedures shall be established and maintained for the testing, calibration, and use of the primary and backup spent fuel pool instrument channels.

2.3 Testing and Calibration: Processes shall be established and maintained for scheduling and implementing necessary testing and calibration of the primary and backup spent fuel pool level instrument channels to maintain the instrument channels at the design accuracy.

On August 29, 2012, the NRC issued an Interim Staff Guidance document (the ISG), JLD-ISG-2012-03, "Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation" (ADAMS Accession No. ML12221A339), to describe methods acceptable to the NRC staff for complying with Order EA-12-051. The ISG endorses, with exceptions and clarifications, the methods described in the Nuclear Energy Institute (NEI) guidance document NEI 12-02, Revision 1, "Industry Guidance for Compliance with NRC Order EA-12-051, 'To Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation,'" dated August 2012 (ADAMS Accession No. ML12240A307). Specifically, the ISG states:

> The NRC staff considers that the methodologies and guidance in conformance with the guidelines provided in NEI 12-02, Revision 1, subject to the clarifications and exceptions in Attachment 1 to this ISG, are an acceptable means of meeting the requirements of Order EA-12-051.

3.0 TECHNICAL EVALUATION

3.1 Background and Schedule

MNS, Units 1 and 2, have separate SFPs, one for each unit.

The licensee submitted its OIP on February 28, 2013. The OIP states that installation of the SFP level instrumentation at MNS will be completed by fall 2014, for Unit 1, and fall 2015, for Unit 2, which is before startup from the second refueling outage for each unit.

The NRC staff has reviewed the licensee's schedule for implementation of SFP level instrumentation provided in its OIP. If the licensee completes implementation in accordance with this schedule, it would appear to achieve compliance with Order EA-12-051 within two refueling cycles after submittal of the OIP and before December 31, 2016.

3.2 Spent Fuel Pool Water Levels

Attachment 2 of Order EA-12-051 states, in part, that

> All licensees identified in Attachment 1 to this Order shall have a reliable indication of the water level in associated spent fuel storage pools capable of supporting identification of the following pool water level conditions by trained personnel: (1) level that is adequate to support operation of the normal fuel pool cooling system [Level 1], (2) level that is adequate to provide substantial radiation shielding for a person standing on the SFP operating deck [Level 2], and (3) level where fuel remains covered and actions to implement make-up water addition should no longer be deferred [Level 3].

NEI 12-02 states, in part, that

> Level 1 represents the HIGHER of the following two points:
>
> - The level at which reliable suction loss occurs due to uncovering of the coolant inlet pipe, weir or vacuum breaker (depending on the design), or
>
> - The level at which the water height, assuming saturated conditions, above the centerline of the cooling pump suction provides the required net positive suction head specified by the pump manufacturer or engineering analysis

In its OIP, the licensee stated that Level 1 would be set at elevation 769 feet (ft.) which is the minimum required level to provide adequate pump suction.

In its letter dated July 11, 2013, the licensee stated, in part, that

> The normal SFP water level is 771.4' Elevation. The SFP cooling pump suction piping submergence is lost when water level decreases below 767.8' Elev. Abnormal procedures secure the SFP cooling pump when water level decreases to 2' below normal. Thus, the NEI 12-02 "Level 1" datum is considered to be 769.4' Elevation.

The NRC staff notes that Level1 is located at elevation 769.4 ft. and that this level is adequate for normal SFP cooling system operation and it is also adequate to ensure the required fuel pool cooling pump Net Positive Suction Head (NPSH). The staff also notes that this level represents the higher of the two points described in NEI 12-02 for Level 1.

NEI 12-02 states, in part, that

> Level 2 represents the range of water level where any necessary operations in the vicinity of the spent fuel pool can be completed without significant dose consequences from direct gamma radiation from the stored spent fuel. Level 2 is based on either of the following:
>
> - 10 feet (+/- 1 foot) above the highest point of any fuel rack seated in the spent fuel pools, or
>
> - a designated level that provides adequate radiation shielding to maintain personnel radiological dose levels within acceptable limits while performing local operations in the vicinity of the pool. This level shall be based on either plant-specific or appropriate generic shielding calculations, considering the emergency conditions that may apply at the time and the scope of necessary local operations, including installation of portable SFP instrument channel components.

In its OIP, the licensee stated that Level 2 would be set at elevation 756 ft. which is the level adequate to provide substantial radiation shielding for a person standing on the SFP operating deck. The licensee also stated that this level provides substantial personnel radiation shielding that would allow implementation of local SFP make-up strategies for a BDB event.

In its letter dated July 11, 2013, the licensee provided a sketch showing the approximate location of the level sensor and the elevations identified as Levels 1, 2 and 3. This sketch shows Level 2 at an elevation of 756 ft. which is approximately 10 ft. above the top of the fuel rack.

The NRC notes that the licensee designated Level 2 using the first of the two options described in NEI 12-02 for Level 2.

In its OIP, the licensee stated that if applicable, the licensee would evaluate adjacent hardware stored in the SFP to ensure it cannot adversely interact with the SFP level instrumentation. In its letter dated June 13, 2013, the NRC staff requested information regarding the impact of the varied dose rates from adjacent hardware stored in the SFP on the identified elevation for Level 2.

In its letter dated, July 11, 2013, the licensee stated, in part, that

> Adjacent SFP hardware stored in the vicinity of the primary SFP level instrumentation will be evaluated with-respect to potential physical seismic interaction and interference with proper operation of the primary level instrumentation. The primary SFP level instrumentation located in the SFP area contains no organic materials which are susceptible to degradation due to exposure to radiation, heat, or steam.
>
> The back-up SFP level channel is remotely located from the SFP area, thus there are no associated interaction concern(s) with adjacent hardware/tools stored in the SFP.

The NRC staff has concerns with the licensee's lack of information regarding any additional analysis to be performed to determine the projected dose rate impact and the appropriate Level 2 value adjustments, if necessary. The staff has identified this request as:

RAI #1

Please provide the information regarding the analysis to be performed to determine the projected dose rate impact and the appropriate Level 2 value as a result of any irradiated hardware/tools stored in the SPF.

MNS Response to RAI #1:

As previously noted, Level 2 for MNS was selected to be that specified by NEI 12-02, Section 2.3.2 (first bullet), "*10 feet (+/-1 foot) above the highest point of any fuel rack seated in the spent fuel pools.*" Thus, per the NEI 12-02 guidance, no additional dose analyses is required to demonstrate this level would provide adequate personnel shielding to support local SFP make-up actions.

The Unit 1 and 2 SFPs do not contain stored irradiated hardware or tools that could present a significant dose contribution to personnel or the spent fuel level instrumentation for the postulated abnormal SFP Level 2 (756' elevation).

Based on the foregoing discussion, no additional analyses is required.

NEI 12-02 states, in part, that

> Level 3 corresponds nominally (i.e., +/- 1 foot) to the highest point of any fuel rack seated in the spent fuel pool. Level 3 is defined in this manner to provide the maximum range of information to operators, decision makers and emergency response personnel.

In its OIP, the licensee stated that Level 3 would be set at elevation 746ft. which is the level where fuel remains covered and actions to implement make-up water addition should no longer be deferred.

In its letter dated July 11, 2013, the licensee provided a sketch showing the approximate location of the level sensor and the elevations identified as Levels 1, 2 and 3. This sketch shows Level 3 at an elevation of 746 ft. which is approximately 10 ft. above the top of the fuel rack. The NRC staff reviewed this sketch and notes that the elevation provided for Level 3 is above the highest point of any spent fuel storage rack seated in the SFP.

The licensee's proposed plan, with respect to identification of Levels 1 and 3, appears to be consistent with NEI 12-02, as endorsed by the ISG.

3.3 <u>Design Features: Instruments</u>

Attachment 2 of Order EA-12-051, states, in part, that

> The instrumentation shall consist of a permanent, fixed primary instrument channel and a backup instrument channel. The backup instrument channel may be fixed or portable. Portable instruments shall have capabilities that enhance the ability of trained personnel to monitor spent fuel pool water level under conditions that restrict direct personnel access to the pool, such as partial structural damage, high radiation levels, or heat and humidity from a boiling pool.

NEI 12-02 states, in part, that

> A spent fuel pool level instrument channel is considered reliable when the instrument channel satisfies the design elements listed in Section 3 [Instrumentation Design Features] of this guidance and the plant operator has fully implemented the programmatic features listed in Section 4 [Program Features].

In its OIP, the licensee stated, in part, that

> The SFP level instrumentation will consist of two permanently installed instruments for each SFP, which will provide continuous SFP level indication.
>
> The remote level indication range will be specified to support monitoring SFP levels above the minimum allowed Technical Specification 3.7.13, "Spent Fuel Pool Water Level," (e.g. ~769' Elevation or ≥23 ft over the top of irradiated fuel assemblies seated in the storage racks), and the top of the fuel storage racks at 746' Elev. At least one of the instrument channels will provide remote control room indication.

In its letter dated July 11, 2013, the licensee provided a sketch depicting that the approximated level measurement range is 29 ft. from the high pool level elevation to the top of the spent fuel racks.

The NRC staff notes that the range specified for the licensee's instrumentation will cover Levels 1, 2, and 3 as described in Section 3.2 above. The licensee's proposed plan, with respect to the number of channels and the range of the instrumentation for both of its SFPs, appears to be consistent with NEI 12-02, as endorsed by the ISG.

3.4 Design Features: Arrangement

Attachment 2 of Order EA-12-051, states, in part, that

> The spent fuel pool level instrument channels shall be arranged in a manner that provides reasonable protection of the level indication function against missiles that may result from damage to the structure over the spent fuel pool. This protection may be provided by locating the primary instrument channel and the fixed portions of the backup instrument channel, if applicable, to maintain instrument channel separation within the spent fuel pool area, and to utilize inherent shielding from missiles provided by existing recesses and corners in the spent fuel pool structure.

NEI 12-02 states, in part, that

> The intent of the arrangement requirement is to specify reasonable separation and missile protection requirements for permanently installed instrumentation used to meet this order. Although additional missile barriers are not required to be installed, separation and shielding can help minimize the probability that damage due to an explosion or extreme natural phenomena (e.g., falling or wind-driven missiles) will render fixed channels of SFP instrumentation unavailable. Installation of the SFP instrument channels shall be consistent with the plant-specific SFP design requirements and should not impair normal SFP function.
>
> Channel separation should be maintained by locating the installed sensors in different places in the SFP area.

In its OIP, the licensee stated, in part that

> In accordance with the guidance in NEI 12-02, the level instruments/channels will be installed in diverse locations and physically arranged in a manner that provides reasonable protection of the level indication function against missiles that may result from damage to the structure over the SFP.
>
> The associated cabling, power supplies and indication each level instrument/channel will be routed separately from each other. Cable routings will be specified to provide reasonable protection from missiles that may result from damage to the structure over the SFP and refuel floor, as applicable. The conduit and cable routing will be determined by the detailed design.

In its letter dated July 11, 2013, the licensee stated, regarding the primary SFP level channel, in part, that

> The wave guided radar pipe is routed slightly above the SFP operating deck, and through a floor core bore penetration down to the sensor electronics located on the 767' Elevation of the Auxiliary Building, and indication/display is provided in the main control room.

> A local control panel is located adjacent to the sensor electronics located on the 767' Elevation of the Auxiliary Building. The local control panel houses a field level indication/display and the battery back-up power supply. A field routed cable connects the control panel to the adjacent sensor electronics. The signal cable is routed from the sensor electronics to the cable spread room and to the indication on the main control board 1/2MC9. All associated channel electronics, and power/signal cabling are located in the Seismic Category 1 Auxiliary Building, and/or Control Room.

In its letter dated July 11, 2013, the licensee stated, regarding the secondary SFP level channel, in part, that

> The back-up SFP level channel is a mechanical pressure gauge and requires no power supply, nor signal cable. The back-up SFP level channel display/read-out is located on the 733' Elevation of the Auxiliary Building in the electrical penetration room.

In its letter dated July 11, 2013, the licensee provided two figures showing the SFP area and primary SFP level channel location. The licensee also provided a figure showing the SFP area and back-up SFP level channel and display location.

The NRC staff notes from the sketch provided for the back-up channel that the centerline of the SFP transfer tube, where the process connection is located, is at elevation 733ft. 6 inches (in.), while the back-up instrument level display is located at elevation 733ft. 4 in. The NRC staff has concerns with the slope between the process connection and the display for the back-up instrument. It appears from the sketch that with the current design, an accessible high point vent valve and a low point drain valve will not be provided. The staff has identified this request as:

RAI #2

Please provide a description of the back-up instrument's required slope for the impulse tubing between the process zero reference point and the read-out/display; how the required slope is maintained in the proposed design, and why the distance between the back-up instrument's process zero reference point and the read-out/display is within the plant instrumentation design criteria.

<u>McGuire Response to RAI #2:</u>

The Instrumentation and Controls Field Installation Specification outlines instrumentation impulse tubing slope requirements. The specification generally requires a minimum slope of ¼" per linear foot. The specification provides recommendations for impulse tubing slope requirements and has provisions to allow engineering exception to the general requirements. Typically if exceptions are taken to the minimum slope requirements, then the design would include provisions for installation of vent/drain valves as applicable. The design of the back-up SFP level channel instrument impulse tubing included an accessible high point vent valve above the display/gauge to facilitate fill and vent. Thus, the impulse tubing slope is judged not to be a concern.

The Instrumentation and Controls Field Installation Specification does not specify a maximum distance/length limitation for process instrument impulse lines.

The NRC staff has concerns with the effects that outside temperature and borated water within the impulse line and at the process tap on the SFP transfer tube may have on the back-up instruments. The staff has identified these requests as:

RAI #3

Please describe what precautions will be taken to ensure the back-up instrument's non-flowing sensing line does not become susceptible to freezing during cold outside temperatures.

McGuire Response to RAI #3:

The back-up SFP level instrument impulse tubing is confined to the lower elevations (725' to 735' Elevation) of the Reactor Building Annulus and Auxiliary Building areas which are below site grade elevation @760' Elevation. The surrounding subterranean ground temperature and Reactor Building concrete thermal inertia would serve to moderate the Reactor Building annulus and Auxiliary Building temperatures due to outdoor temperature extremes. During a postulated BDB event additional annulus heat input would be expected to occur through the containment steel vessel wall from lower containment. Based on engineering judgment, the relative temperate climate associated with the McGuire site location could not support sustained cold outdoor temperature conditions which could result in freezing of the back-up SFP level instrument sensing line.

With-respect to boric acid precipitation, the SFP process contains ~1.6 weight-percent boric acid, which has a solubility temperature <32°F. Thus, boric acid precipitation would not be expected to occur during postulated low ambient temperature conditions.

RAI #4

Please clarify if the back-up instrument contains a sealed capillary system and provide a description of what precautions will be taken to prevent crud build-up within the sensing line.

McGuire Response to RAI #4:

The back-up SFP level instrument will not be equipped with a sealed capillary system. This design is similar to other borated water sensing instrumentation associated with the Refueling Water Storage Tank (RWST), concentrated boric acid storage tank, and the SFP system. Extensive operating experience on similar process instrumentation applications demonstrates acceptable reliability. The operating experience readily supports that crud build-up within the instrument sense line tubing is not an issue. Furthermore, periodic SFP level instrument channel checks will provide a means for early detection of potential sense line blockage. Based on the foregoing discussion, no special precautions are required to prevent crud build-up within the sensing line.

The NRC staff has concerns with the licensee's lack of information regarding the arrangement of the SFP level instruments. The staff has identified these requests as:

RAI #5

Please provide a clearly labeled sketch or marked-up plant drawing of the plan view of the SFP area, depicting the SFP inside dimensions, the planned locations/placement of the primary and back-up SFP level sensor, and the proposed routing of the cables that will extend from the sensors toward the location of the read-out/display device.

(This information was previously requested as RAI-2 in the NRC letter dated June 13, 2013)

McGuire Response to RAI #5:

Plan view sketches depicting the proposed SFP level channel layout were previously provided in the McGuire RAI response dated July 11, 2013. Figures 1 and 2 of the prior response depicted an elevation view for the primary and back-up SFP level channels. Figure 3 of the prior response depicted the SFP inside dimensions, the fuel transfer canal, fuel transfer tube, and proposed placement of the primary SFP level instrument wave-guided radar piping. Figure 4 of the prior response depicted the back-up SFP level instrument impulse tubing route within the Reactor Building annulus and the local field display/gauge location. The figures were provided for Unit 1, and are typical for Unit 2.

The proposed routing for the primary level channel cabling is depicted in Figures 1-4 and Figures 5-8 for Units 1 and 2, respectively. Figures 2 and 7 depict the relative proximity of the back-up channel components to the primary channel components. The primary level channel and associated cable route layout is completely separated from all components of the back-up level channel by walls and/or floors of the Seismic Category I Auxiliary Building. The order, ISG and NEI 12-02 guidance physical arrangement/separation requirements are satisfied based on the following considerations:

- The primary channel radar horn and a wave guided pipe are the only components located in the SFP Building, which does not provide complete protection against wind driven missiles. Reasonable protection for these primary channel components is afforded as described in the RAI #6 response.

- Only the primary channel has associated cabling, which is entirely confined within a Seismic Category I structure which is protected from external events and postulated wind driven missiles.

- The back-up channel is entirely confined within Seismic Category I structures, and is fully protected from postulated wind driven missiles.

- The components of the primary channel are afforded physical separation from those of the back-up channel from the walls and/floors of a Seismic Category I structure(s) (primary channel components are located on building elevations above those for the back-up channel).

RAI #6

Please provide additional information describing how the proposed final arrangement of the primary SFP level instrumentation and routing of the cabling between the level instruments, the electronics and the displays, meets the Order requirement to arrange the SFP level instrument channels in a manner that provides reasonable protection of the level indication function against missiles that may result from damage to the structure over the SFP.

McGuire Response to RAI #6:

The primary level channel wave guided pipe and horn are mounted to the SFP operating deck floor (~779' Elevation) at the south end of the SFP Building. This location affords reasonable protection from a postulated missile emanating from the north wall of the SFP Building, which was not designed for missile protection. The remaining SFP Building walls and ceiling are designed Seismic Category I. The wave guided pipe passes through a penetration in the SFP operating deck floor, and is connected to the electronic sensor/transmitter which is located on the lower elevation (767' elevation) of the Seismic Category I Auxiliary Building wall. With the exception of the radar horn and wave guided piping on the SFP operating deck, the balance of the primary channel components and cabling are contained within a seismic Category I structure, and are protected from potential wind driven missiles. Refer to the RAI #5 response for detailed routing of the primary channel cabling.

The back-up level channel consists of instrument sense-line tubing which is connected to the SFP transfer tube inside the Reactor Building annulus and is routed to a mechanical pressure gauge located on the 733' elevation of the Auxiliary Building. The back-up channel is entirely contained within Seismic Category I structures, and protected from wind driven missiles. The back-up level channel contains no powered electronics, or power/signal cable.

3.5 Design Features: Mounting

Attachment 2 of Order EA-12-051 states, in part, that

Installed instrument channel equipment within the SFP shall be mounted to retain its design configuration during and following the maximum seismic ground motion considered in the design of the SFP structure.

NEI 12-02 states, in part, that

The mounting shall be designed to be consistent with the highest seismic or safety classification of the SFP. An evaluation of other hardware stored in the SFP shall be conducted to ensure it will not create adverse interaction with the fixed instrument location(s).

The basis for the seismic design for mountings in the SFP shall be the plant seismic design basis at the time of submittal of the Integrated Plan for implementing NRC Order EA-12-051.

In its OIP, the license stated that the permanently installed instruments would be mounted to retain the component design configuration during and following the maximum seismic ground motion considered in the design SFP structure or applicable structure in which the component is located.

In its letter dated July 11, 2013, the licensee stated regarding the primary and back-up SFP level channels, in part, that

> Potential physical interaction effects of SFP hardware/tools in the vicinity of the primary SFP level sensor will be evaluated as described in response to RAI #1 b), and are not applicable to the remotely located SFP back-up level channel.
>
> As part of the engineering change process, procedural controls are planned to govern storage of SFP equipment and to avoid the potential for adverse interaction with the primary SFP level channel.

The NRC staff has concerns with the licensee's lack of information regarding the seismic design of the mounting for the SFP level instrumentation. The staff has identified these requests as:

RAI #7

Please provide the following:

a) **The design criteria that will be used to estimate the total loading on the mounting device(s), including static weight loads and dynamic loads. Describe the methodology that will be used to estimate the total loading, inclusive of design basis maximum seismic loads and the hydrodynamic loads that could result from pool sloshing or other effects that could accompany such seismic forces.**

b) **A description of the manner in which the level sensor (and stilling well, if appropriate) will be attached to the refueling floor and/or other support structures for each planned point of attachment of the probe assembly. Indicate in a schematic the portions of the level sensor that will serve as points of attachment for mechanical/mounting or electrical connections.**

c) **A description of the manner by which the mechanical connections will attach the level instrument to permanent SFP structures so as to support the level sensor assembly.**

McGuire Response to RAI #7 a):

Potential SFP sloshing effects due to a postulated seismic event will be evaluated for the primary level channel. Applicable hydrodynamic wave impact forces will be included in the radar horn/pipe mounting load combinations. Based on the available McGuire SFP free-board, it is expected the sloshing analyses will conclude wave impact on the radar horn/piping is not credible.

The primary channel, which consist of the electronic sensor/transmitter, horn, and wave guide piping, is mounted seismically. The mounting designs for the electronic sensor support, horn support, and intermediate supports were qualified considering the total weight of the wave guide piping and its components and the seismic accelerations for the building structure. To meet the design criteria for a BDB Event, the loading for the mounting supports were generated using a minimum of 2xSSE seismic accelerations. The mounting designs for these supports are qualified by calculations using the Manual For Steel Construction AISC 9th Edition, Hilti Product Technical Guides, and site specific specifications.

The electronic sensor mounting support is qualified by a generic calculation using a simple C-channel steel section that is welded centrally on a ½" thick steel base plate on the Auxiliary Building concrete wall. The base plate is anchored to the wall with four (4) concrete anchor bolts. The generic sensor mounting support was designed for generic enveloping seismic accelerations of 10g (horizontal) and 6.67g (vertical), which readily envelopes the site seismic response spectra. The calculation further assumed an enveloping sensor cantilevered length.

However, considering that this qualification uses very conservative generic accelerations compared to the 2xSSE design criteria, design seismic accelerations were used which are less than the generic accelerations but are much greater than the 2xSSE accelerations. Conservatively, 50% of the generic accelerations were used in the qualification for the anchorage of the electronic sensor mounting. This 50% reduction in the generic accelerations is still greater than the 2xSSE design criteria accelerations.

The horn mounting support is qualified similarly to the sensor mounting support. It is qualified by a site specific calculation using a simple C-channel steel section welded on a ½" thick base plate on the concrete operating deck floor in the SFP area. The base plate is anchored to the floor with four (4) concrete anchor bolts. The horn mounting support conservatively uses generic seismic accelerations of 10g (horizontal) and 6.67g (vertical). The actual cantilevered length used in this qualification is 3" from the floor. A visual representation of the pool edge mounting configuration for the radar horn is depicted in Figure 11 and provides mounting configuration.

The intermediate mounting supports are qualified by a site specific calculation. These mounting supports consist of U-bolting the pipe to a steel angle and welding the steel angle to a ¾" thick steel base plate. The base plate is anchored either to the Auxiliary Building concrete wall or to the concrete operating deck floor in the SFP area. The intermediate mounting supports uses the 2xSSE design seismic accelerations of 3.45g (horizontal) and 0.50g (vertical).

All of the mounting supports for the wave guide piping are attached to either the concrete wall or concrete floor. These concrete structures have a minimum concrete strength of 3000 psi.

The mounting design for the power control panel is qualified considering the total weight of the panel and its associated components and the seismic accelerations for the building structure. To meet the design criteria for a BDB Event, the loading for the panel was generated using a minimum of 2xSSE seismic accelerations. The mounting design for the power control panel is qualified by calculations using the Manual For Steel Construction AISC 9th Edition, Hilti Product Technical Guides, and site specific specifications.

McGuire Response to RAI #7 b) & c):

The wave guide piping assembly, horn, and electronic sensor are designed to attach to the SFP concrete floor and the Auxiliary Building concrete wall by means of mounting supports. These mounting supports consists of a sensor support, horn support, and intermediate supports. Spacing of the mounting supports comply with site specific specifications and standards and qualification restrictions for the wave guide pipe assembly. Figures 9 and 10 depict the planned attachment points for the wave guided piping and horn assembly for Units 1 and 2, respectively.

The electronic sensor mounting support is designed using a simple C-channel steel section that is welded centrally on a ½" thick steel base plate on the Auxiliary Building concrete wall. The base plate is anchored to the wall with four (4) concrete anchor bolts. The cantilevered length from the pipe to the wall is 10".

The horn mounting support is designed using a simple C-channel steel section that is welded on a ½" thick base plate on the SFB Building concrete floor. The base plate is anchored to the floor with four (4) concrete anchor bolts. The cantilevered length from the pipe to the floor is 3".

The intermediate mounting supports consists of U-bolting the wave guide pipe to a steel angle and welding the steel angle to a ¾" thick steel base plate. The base plate is anchored to the concrete wall with four (4) concrete anchor bolts in the Auxiliary Building and anchored to the concrete floor with four (4) concrete anchor bolts in the SFP area.

The power control panel is designed to attach to the Auxiliary Building concrete wall. The mounting of the power control panel consists of bolting the power control panel to two sections of unistrut using 3/8" A307 bolts. Each section of unistrut is anchored to the wall with two (2) concrete anchor bolts.

In addition, the staff plans to verify the results of the licensee's seismic testing and analysis when it is completed based on the licensee's response to the following RAIs.

RAI #8

For RAI 7(a) above, please provide the analyses used to verify the design criteria and methodology for seismic testing of the SFP instrumentation and the electronics units, including, design basis maximum seismic loads and the hydrodynamic loads that could result from pool sloshing or other effects that could accompany such seismic forces.

McGuire Response to RAI #8:

Potential SFP sloshing effects due to a postulated seismic event will be evaluated for the primary level channel. Applicable hydrodynamic wave impact forces will be included in the primary level channel radar horn/pipe mounting load combinations. Based on the available McGuire SFP free-board, it is expected the sloshing analyses will conclude wave impact on the radar horn/piping is not credible.

The Required Response Spectra (RRS) used for seismic testing of the SFP primary level instrumentation and the electronics units envelop the MNS design basis seismic spectra for the locations where the equipment will be installed. The seismic testing and analysis performed is in accordance with IEEE 344-2004 methodology per site procedures. Refer to RAIs # 17 and #21 responses for additional detail.

RAI #9

For each of the mounting attachments required to attach SFP Level equipment to plant structures, please describe the design inputs, and the methodology that was used to qualify the structural integrity of the affected structures/equipment.

McGuire Response to RAI #9:

Refer to RAI #7 Response.

In its OIP, the licensee stated that, if applicable, adjacent hardware stored in the SFP would be evaluated to ensure it cannot adversely interact with SFP level instrumentation.

The NRC staff has concerns with the licensee's lack of information regarding the interaction that other adjacent hardware stored in the SFP could have with the SFP level instrumentation during a seismic event. The staff has identified this request as:

RAI #10

Please provide the results of the evaluation performed, if applicable, to ensure that other hardware stored in the SFP cannot adversely interact with the SFP level instrumentation.

McGuire Response to RAI #10:

The evaluation concluded the SFP level instrumentation would not be exposed to any adverse seismic interactions from surrounding SFP equipment/hardware. This conclusion was based on: i) surrounding permanent plant equipment/hardware, and structures in the vicinity are seismically mounted, ii) site procedural controls ensure temporary equipment/material is properly located/secured so as to prevent the potential for adverse seismic interactions.

3.6 Design Features: Qualification

Attachment 2 of Order EA-12-051 states, in part, that

The primary and backup instrument channels shall be reliable at temperature, humidity, and radiation levels consistent with the spent fuel pool water at saturation conditions for an extended period. This reliability shall be established through use of an augmented quality assurance process (e.g. a process similar to that applied to the site fire protection program).

NEI 12-02 states, in part, that

> The instrument channel reliability shall be demonstrated via an appropriate combination of design, analyses, operating experience, and/or testing of channel components for the following sets of parameters, as described in the paragraphs below:
>
> - conditions in the area of instrument channel component use for all instrument components,
> - effects of shock and vibration on instrument channel components used during any applicable event for only installed components, and
> - seismic effects on instrument channel components used during and following a potential seismic event for only installed components.

The NRC staff assessment of the instrument qualification is discussed in the following subsections below: (3.6.1) Augmented Quality Process, (3.6.2) Post Event Conditions, (3.6.3) Shock and Vibration, and (3.6.4) Seismic Reliability.

3.6.1 Augmented Quality Process

Appendix A-1 of the guidance in NEI 12-02 describes a quality assurance process for non-safety systems and equipment that is not already covered by existing quality assurance requirements. Within the ISG, the NRC staff found the use of this quality assurance process to be an acceptable means of meeting the augmented quality requirements of Order EA-12-051.

In its OIP, the licensee stated, in part, that

> Augmented Quality provisions will be applied to ensure the rigor of the qualification documentation reviews and in-plant modification installation oversight is sufficient to ensure compliance with the qualification requirements above. This approach to quality assurance is consistent with the guidance in NRC JLD-ISG-2012-03 and NEI 12-02.

The licensee's proposed augmented quality assurance process appears to be consistent with NEI 12-02, as endorsed by the ISG.

3.6.2 Post Event Conditions

NEI 12-02 states, in part, that

> The temperature, humidity and radiation levels consistent with conditions in the vicinity of the [SFP] and the area of use considering normal operational, event and post-event conditions for no fewer than seven days post-event or until off- site resources can be deployed by the mitigating strategies resulting from Order EA-12-049 should be considered. Examples of post-event (beyond-design-basis) conditions to be considered are:
>
> - radiological conditions for a normal refueling quantity of freshly discharged(100 hours) fuel with the SFP water level 3 as described in this order,

- temperatures of 212 degrees F and 100% relative humidity environment,
- boiling water and/or steam environment
- a concentrated borated water environment, and...

In its OIP, the licensee stated, in part, that

> The level instrumentation shall remain functional and maintain required accuracy capability after a Safe shutdown Earthquake, and/or after exposure to any applicable harsh environmental conditions for the equipment location. The level instrumentation and associated cabling will be specified to be reliable at the maximum temperature, humidity, and radiation levels predicted during an extended loss of AC power (ELAP) event at their installed locations.

In its letter dated July 11, 2013, the licensee stated that because the back-up SFP level instrument channel is a mechanical device, it will not be exposed to SFP steam or radiation. Furthermore, the licensee noted that the mechanical pressure gauge will be seismically mounted and its reliability is based on the successful operating history of similar type analog devices. The gauge design temperature limits would be suitable for the location environment.

Regarding the primary SFP level channel, in its letter dated July 11, 2013, the licensee stated that the primary SFP level channel instrumentation reliability would be established based on a combination of similarity analyses, testing, and operating experience.

Related to the impact of post-event temperature conditions on the primary SFP level instrument channel, in its letter dated July 11, 2013, the licensee stated, in part, that

> The postulated temperature in the spent fuel pool area that results from a boiling pool is 100°C (212°F). The radar sensor electronics will be located outside of the spent fuel pool room in an area where the temperature will not exceed the radar sensor electronics rated design temperature.

The NRC staff has concerns with the lack of information regarding the ambient temperature in the location where the sensor electronics will be located under normal and worst case postulated conditions. The staff has identified this request as:

RAI #11

Please provide information indicating what will be the maximum expected ambient temperature in the room in which the sensor electronics will be located under BDB conditions in which there is no ac power available to run Heating Ventilation and Air Conditioning (HVAC) systems.

<u>McGuire Response to RAI #11:</u>

Formal analyses were performed for more limiting areas of the Auxiliary Building during a postulated ELAP event (e.g. turbine driven auxiliary feedwater pump room, 4 kV essential switchgear room). The analyses concluded ambient temperatures for the more limiting locations would not exceed 120°F after 7 days without mitigating cooling actions. Based on engineering judgment, the ambient temperature analyses for these areas would readily bound those associated with the location of the primary SFP level instrumentation electronics. The primary channel sensor and power/control panel are located on the 767' elevation of the Auxiliary Building, in the vicinity of HVAC equipment which would be idle during a postulated ELAP event. The limiting ambient design temperature for the primary channel sensor and power/control panel components is 158°F, and is judged to be acceptable for the proposed location.

Related to the impact of post-event humidity conditions on the primary SFP level instrument channel, in its letter dated July 11, 2013, the licensee stated, in part, that

> The maximum humidity postulated for the spent fuel pool area is 100% relative humidity, saturated steam. The radar sensor electronics will be located outside of the spent fuel pool room in an area away from the steam atmosphere. The waveguide pipe can tolerate condensation formation on the inner wall surface, provided condensate pooling does not occur within the waveguide pipe. Condensate pooling is prevented by installing a weep hole(s) at the low point(s) in the wave guide pipe.

Related to the impact of post-event steam conditions on the primary SFP level instrument channel, in its letter dated July 11, 2013, the licensee stated, in part, that

> The ability of the radar wave to propagate through steam has been demonstrated by vendor testing. In addition through air radar has been used in numerous applications that involve measuring the level of boiling liquids. The vendor manual contains a table that provides accuracy correction factors for superimposed gas or vapor including saturated steam at various pressures. Therefore, successful operating experience has demonstrated that the through air radar functions at high levels of steam saturation.

The NRC staff has concerns with the licensee's lack of information regarding the associated sensor electronics capability of continuously performing its required functions under the expected humidity condition. The staff has identified this request as:

RAI #12

Please provide information indicating the maximum expected relative humidity in the room in which the associated sensor electronics will be located under BDB conditions, in which there is no ac power available to run HVAC systems, and whether the sensor electronics is capable of continuously performing its required functions under this expected humidity condition.

McGuire Response to RAI #12:

The primary channel sensor and power/control panel are located on the 767' elevation of the Auxiliary Building, and would not be exposed to saturated steam conditions potentially present in the SFP area. The ambient humidity in this location during a postulated ELAP event would be expected to be below 100% RH.

The sensor has been tested in accordance with IEC 60068-2-30, which varies the room temperature from room temperature to elevated temperature at high humidity conditions, to verify that the test item withstands condensation that can occur due to the changing conditions. The sensor is rated IP66/IP68, which signifies totally dust tight housing, protection against string water jets and waves, and protection against prolonged effects of immersion under 0.2 bar pressure and has been tested to EN 60529:2000.

The power/control panel enclosure is rated NEMA 4X and provides protection to the internal components from the effects of high humidity environments.

Based on the foregoing discussion, the sensor electronics are capable of continuously performing their required function.

Related to the impact of post-event radiological conditions on the primary SFP level instrumentation channel, in its letter dated July 11, 2013, the licensee stated, in part, that

> The area above and around the pool will be subject to large amounts of radiation in the event water level decreases near the top of the fuel racks. The only parts of the measurement channel in the pool radiation environment are the metallic waveguide and horn, which are not susceptible to the expected levels of radiation. The sensor electronics will be located in an area that does not exceed their 1×10^3 rad design limit for the required operating time, or the design will provide shielding as required.

The NRC staff has concerns with the licensee's lack of information regarding its analysis of the maximum expected radiological conditions for the location of the sensor electronics that might be considered credible under BDB conditions. The staff is also concerned with the lack of documentation indicating how it was determined that the electronics can withstand a total integrated dose of $1X10^3$ Rads. The staff has identified this request as:

RAI #13

Please provide analysis of the maximum expected radiological conditions (dose rate and total integrated dose) for the location of the sensor electronics that might be considered credible under BDB conditions. Also, please provide documentation indicating how it was determined that the electronics for this equipment is capable of withstanding a total integrated dose of $1X10^3$ Rads. Please discuss the time period over which the analyzed total integrated dose was applied.

McGuire Response to RAI #13:

The primary level channel radar wave guided pipe connects to an electronic sensor, which is located in the adjacent Auxiliary Building. The sensor electronics are located within the Auxiliary Building at an elevation below the SFP operating deck. The location of the electronics is shielded from the direct shine from the fuel, and bounce and scatter effects above the pool. The sensor is shielded from SFP area dose during a postulated event with SFP level at Level 3 as follows: i) horizontally by a 4' thick concrete wall between the SFP and the Auxiliary Building, and ii) by the 3' thick concrete floor below.

A location specific dose analysis was performed to determine the expected sensor dose for a postulated BDB event with SFP level at the top of the fuel racks (NEI 12-02 Level 3). The analysis determined the total integrated dose (TID) for a postulated BDB event with SFP at Level 3 to be ~119 Rads over the expected maximum 7 day mission time (NEI 12-02, Section 3.4). The associated BDB dose-rate at the electronics location was calculated to be 0.50 Rad/hr.

NRC Bulletin 79-01B, Table C-1 specifies the radiation susceptibility thresholds for various materials. The most susceptible material specified is integrated circuit N-MOS material with a susceptibility threshold of $1x10^3$ rad. The safety evaluation report (NUREG-173, Chapter 3.11.3.2.1) for the current generation of operating reactors defines a mild radiation environment for electronic components (e.g. semiconductors, or any electronic component containing organic materials) as a TID of less than $1x10^3$ rad. Regulatory Guide 1.209 further supports this threshold for electronics and states "*ionizing dose radiation hardness levels for MOS IC families range from about 10 gray (Gy) or 1 kilorad (krad) for commercial off-the-shelf (COTS) circuits to about 10^5 Gy (10^4 krad) for radiation hardened circuits*". Based on the foregoing discussion, the electronics in the VEGAPULS 62 ER sensor, displays and power control panel are considered to be qualified for $1x10^3$ Rad.

3.6.3 Shock and Vibration

NEI 12-02 states, in part, that

Applicable components of the instrument channels are rated by the manufacturer (or otherwise tested) for shock and vibration at levels commensurate with those of postulated design basis event conditions in the area of instrument channel component use using one or more of the following methods:

- instrument channel components use known operating principles, are supplied by manufacturers with commercial quality programs (such as IS09001) with shock and vibration requirements included in the purchase specification and/or instrument design, and commercial design and testing for operation in environments where significant shock and vibration loadings are common, such as for portable hand-held devices or transportation applications;
- substantial history of operational reliability in environments with significant shock and vibration loading, such as transportation applications, or
- use of component inherently resistant to shock and vibration loadings or are seismically reliable such as cables.

In its letter dated July 11, 2013, the licensee stated, in part

The VEGAPuls 62ER Through Air Radar sensor is similar in form, fit and function to the VEGAPuls 66 that was shock and vibration tested in accordance with MILS-901D and MIL-STD-167-1. This shock and vibration testing only applies to the sensor. The waveguide piping is 1" diameter Schedule 40 piping and is seismically anchored to the floor. Thus the waveguide level system is not considered to be sensitive to shock or vibration.

The power supply panel contains components that are part of the standard VEGA Mobile Remote Display. In addition, the readout portion of the display panel, the PLICSCOM, was installed in the sensor during the shock and vibration testing. The Mobile Remote Display is designed for truck-mounted mobile applications subject to shock and vibration from normal handling, after transportation and setup on the job. Per NEI 12-02, designing instruments for operation in environments where significant shock and vibration loadings are common, such as for portable hand-held devices or transportation applications, is an acceptable measure for verifying that the design is adequate to withstand shock and vibration. This panel is therefore considered to have an acceptable resistance to shock and vibration. There are three components in the AREVA power control panel that are not included with the VEGA Mobile Remote Display but are similar in construction and are tested for shock and vibration and/or mounted on vibration dampeners. This panel also will be subjected to seismic tests.

The main control room display/indicator will be seismically mounted, and is seismically qualified based on similarity to other control board indicators.

The NRC staff notes that the use of MIL-STD-901 D appears to be a reasonable method for shock testing. However, the staff has concerns regarding the licensee's lack of information describing the tests, applied forces, and the operability condition of the sensor after the tests were completed. The staff has identified this request as:

RAI #14

Please provide information describing the evaluation of the comparative sensor design, the shock test method, test results, and forces applied to the sensor applicable to its successful tests demonstrating that the referenced previous testing provides an appropriate means to demonstrate reliability of the sensor under the effects of severe shock.

McGuire Response to RAI #14:

The VEGAPULS 66 Through Air Radar sensor and PLICSCOM indicating and adjustment module mounted to the sensor were shock tested in accordance with MIL-STD-901D. The test results are considered also applicable to the VEGAPULS 62 ER and PLICSCOM indicating and adjustment module. Differences in construction between the VEGAPULS 66 and VEGAPULS 62 ER are mainly in the smaller size of the VEGAPULS 62 ER. The shape of the housing, its material construction (precision cast stainless steel), the mass and form factor for the electronics modules, the materials and method for mounting the electronics into the sensor housing are the same between the VEGAPULS 66 and the VEGAPULS 62 ER.

The MIL-STD-901D test consisted of a total of nine (9) shock blows, three (3) through each of the three (3) principal axes of the sensor, delivered to the anvil plate of the shock machine. The heights of hammer drop for the shock blows in each axis were one (1) foot, three (3) feet and five (5) feet.

The VEGAPULS 62 ER Through Air Radar sensor has also been shock tested in accordance with EN60068-2-27 (100g, 6ms), ten (10) shock blows applied along a radial line through the support flange.

The foregoing testing demonstrates the sensor is reliable under severe shock conditions.

The NRC staff notes that the use of MIL-STD-167-1 appears to be a reasonable method for vibration testing. However, the staff has concerns with the lack of information describing the tests, applied forces and their directions and frequency ranges, or the operability condition of the sensor after the tests were completed. The staff has identified this request as:

RAI #15

Please provide information describing the evaluation of the comparative sensor design, the vibration test method, test results, and the forces and their frequency ranges and directions applied to the sensor applicable to its successful tests, demonstrating that the referenced previous testing provides an appropriate means to demonstrate reliability of the sensor under the effects of high vibration.

McGuire Response to RAI #15:

A VEGAPULS 66 Though Air Radar sensor and PLICSCOM indicating and adjustment module mounted to the sensor were successfully vibration tested in accordance with MIL-STD-167-1. The test results are considered also applicable to the VEGAPULS 62 ER and PLICSCOM indicating and adjustment module. Differences in construction between the VEGAPULS 66 and VEGAPULS 62 ER are mainly in the smaller size of the VEGAPULS 62 ER. The shape of the housing, its material construction (precision cast stainless steel), the mass and form factor for the electronics modules, the materials and method for mounting the electronics into the sensor housing are the same between the VEGAPULS 66 and the VEGAPULS 62 ER.

The vibration test procedure described above applies to equipment found on Navy ships with conventional shafted propeller propulsion. The test frequencies ranged from 4 Hz to 50 Hz with amplitudes ranging from 0.048" at the low frequencies to 0.006" at the higher frequencies. This procedure is not applicable to high-speed or surface effect ships that are subject to vibrations for high-speed wave slap, which produce vibration amplitudes and frequencies in excess of the levels on conventional Navy ships.

The potential vibration environment around the SFP and surrounding building structure might contain higher frequencies than were achieved in the testing discussed above. Additional testing of the VEGA PULS 62 ER sensor was performed in accordance with EN 60068-2-6 Method 204 (except 4g, 200 Hz). This additional testing is considered to provide a stand-alone demonstration of the resistance to vibration of the VEGAPULS 62 ER sensor and further substantiates the results of the MIL-STD-167-1 testing.

The NRC staff has concerns with the licensee's lack of information regarding description of the manufacturer's shock and vibration ratings for the comparative display panel and the results of any testing performed by the manufacturer to achieve those ratings. The staff also plans to verify the licensee's comparison of the magnitude of the manufacturer's ratings against postulated plant conditions under design basis events. The staff has identified this request as:

RAI #16

Please provide information describing the evaluation of the comparative display panel ratings against postulated plant conditions. Also provide results of the manufacturer's shock and vibration test methods, test results, and the forces and their frequency ranges and directions applied to the display panel associated with its successful tests.

McGuire Response to RAI #16:

The components used in the power control panel are listed in the Table 1-1 below, which provides the shock and vibration test and/or analysis for each component. The VEGAPULS 62 ER Through Air Radar sensor has also been shock tested in accordance with EN60068-2-27 (100g, 6ms), ten (10) shock blows applied along a radial line through the support flange.

Table 1-1: Power Control Panel Shock and Vibration Test and Analysis

Component Name	Test standard used	Test levels per manufacturer description
Selector switch	Vibration resistance per IEC 60068-2-6	5 gn (f = 2...500Hz)
	Shock per IEC 60068-2-27	30 gn for 18 ms half sine wave acceleration 50 gn for 11 ms half sine wave acceleration
Terminal blocks	Not tested, These are considered suitable for use in the shock and vibration environments based on their previous use in the manufacturer's mobile remote display.	N/A
Power supply	Vibration tested per IEC 60068-2-6	(Mounting by rail: Random wave, 10-500 Hz, 2G, ea. Along X, Y, Z axes 10 min/cycle, 60 mi)
	Shock tested per IEC 60068-2-27	Half sine wave, 4G, 22 ms, 3 axes, 6 faces, 3 times for each face
Fuse	Vibration tested per MIL-STD-202	Method 204, Test Condition C (Except 5g, 500 Hz)
	Shock tested per MIL-STD-202	Method 207 (HI Shock)
Indicating light	Not tested for shock or vibration resistance. Failure of light will not impact instrument operability.	N/A
Control relay	Not tested, mounted on dampener (See below)	N/A
Battery	Not tested, mounted on dampener (See below)	N/A
Current isolator	Not tested, mounted on dampener (See below)	N/A
Readouts – (See Note 1) below)	Test standards as described in RAI #14 and RAI #15 responses	Test levels as described in RAI #14 and RAI #15 responses

Notes:

1) The VEGA displays will be mounted separately from the power control panel. These displays have the same housing, the same material construction and method for mounting the electronics into the sensor housing as the VEGAPULS 62 ER that has been shock and vibration tested as discussed in the responses to RAI #14 and RAI #15 above.

Three components that were not shock or vibration tested by the manufacturers were included in a power control panel that was successfully seismically tested in accordance with the requirements of the Institute of IEEE Standard 344-2004. The seismic test levels reached peaks of 19g in the x direction, 20g in the y direction, and 21g in the z direction. The test response spectra exceeded 10g at all upper frequencies up to 100 Hz beyond which they were not recorded. Also, these components are mounted to vibration dampeners to further minimize the transfer of external vibration to these components. There are no known reasons that would cause vibration to increase in an ELAP event.

The testing bounds the expected component shock environment and accelerations for the power control panel design mounting location (i.e. concrete walls or rigid metal building structures).

3.6.4 Seismic Reliability

The ISG recommends the use of Sections 7, 8, 9, and 10 of IEEE 344-2004 for seismic qualification of the SFP level instrumentation.

In its letter dated July 11, 2013, the licensee stated, in part, that

> A seismic shake test will be performed to the requirements of IEEE 344-2004 for elements of the VEGAPuls 62ER Through Air Radar to levels anticipated to envelope most if not all plants in the United States. The equipment to be tested includes the sensor, readout and power control panel, horn end of the waveguide, pool end and sensor end mounting brackets, and waveguide piping. The items will be tested to the Required Response Spectra (RRS) contained in EPRI TR-107330 to account for the potentially high seismic motion that could occur to the cabinet-mounted readout and the power control panel. This RRS will also envelop the seismic ground motion for items mounted to the building structure, pool edge, etc. The main control room display/indicator will be seismically mounted, and is seismically qualified based on similarity to other control board indicators.
>
> The back-up SFP level channel is a mechanical pressure gauge that is considered to be seismically rugged. The pressure gauge will be seismically mounted and its reliability is based on the successful operating history for similar type devices.
>
> The seismic testing described in RAI #4 b) includes testing the VEGAPuls 62ER for functionality prior to and post seismic testing, which includes verification of the instrument's accuracy.
>
> The back-up SFP level channel gauge will be seismically mounted and its reliability is established based on successful operating experience that demonstrates it is seismically rugged.

The NRC staff notes that licensee's planned approach with respect to the seismic reliability of the instrumentation appears to be consistent NEI 12-02, as endorsed by the ISG. However, the staff plans to verify the results of the licensee's seismic test when it is completed. The staff has identified this request as:

RAI #17

Please provide analysis of the seismic testing results and show that the instrument performance reliability, following exposure to simulated seismic conditions representative of the environment anticipated for the SFP structures at MNS, has been adequately demonstrated.

McGuire Response to RAI #17:

The sensor, indicator, power control panel, horn end of the waveguide, standard pool end and sensor end mounting brackets, and waveguide piping were successfully seismically tested in accordance with the requirements of the IEEE Standard 344-2004. The system was monitored for operability before and after the resonance search and seismic tests. The required response spectra used for the five Operating Basis Earthquakes (OBE) and one Safe Shutdown Earthquake (SSE) in the test were taken from EPRI TR-107330, Figure 4-5. This test level exceeds the building response spectra where equipment will be located.

Intermediate mounting brackets for the wave guide piping and mounting for the power control panel/terminal box will be designed in accordance with the site specific standards for seismically mounted equipment and pipe supports per Seismic Category II criteria.

3.6.5 *Qualification Evaluation Summary*

Upon acceptable resolution of the RAIs in Section 3.6, the NRC staff will be able to make a conclusion regarding the instrument qualification.

3.7 Design Features: Independence

Attachment 2 of Order EA-12-051 states in part, that

The primary instrument channel shall be independent of the backup instrument channel.

NEI 12-02 states, in part, that

Independence of permanently installed instrumentation, and primary and backup channels, is obtained by physical and power separation commensurate with the hazard and electrical isolation needs. If plant AC or DC power sources are used then the power sources shall be from different buses and preferably different divisions/channels depending on available sources of power.

In its OIP, the licensee stated that the level instruments and any associated cabling (for each Unit SFP) will be physically separated and electrically independent of one another.

In its letter dated July 11, 2013, the licensee stated, in part, that

> The primary and back-up SFP level channels employ diverse sensing technology. The primary SFP level channel consists of a wave guided radar pipe and horn sensing assembly located on the SFP operating deck. The primary channel includes a remote sensor/transmitter and battery back-up power supply that are located in the 767' Elevation of the Auxiliary Building and provide remote control room level display/indication.
>
> The back-up SFP level channel is a mechanical pressure gauge that is remotely located from the SFP area and any primary level channel components/cabling. The back-up level channel monitors SFP level via a process connection to the fuel transfer tube. The associated impulse tubing is routed through the Reactor Building annulus area to the 733' Elevation of the Auxiliary Building, where the read-out/display is located. The back-up level channel does not require electrical power. The back-up level channel is spatially separated and electrically independent from the primary channel.

In addition, in its letter dated July 11, 2013, the licensee noted that the primary SFP level channel is provided nonessential AC power from a local area termination cabinet on 767 ft. Elevation of the Auxiliary Building. Also, the licensee explained that the field routed cable would connect the control panel to the adjacent sensor electronics. Specifically, the signal cable would be routed from the sensor electronics to the cable spread room and to the indication on the main control board 1/2MC9. Regarding the back-up level instrument, the licensee stated that this instrument would not require electrical cables/power, nor battery back-up.

The NRC staff notes that the licensee's proposed independence and physical and power separation appears to be consistent with NEI 12-02, as endorsed by the ISG. This proposed arrangement would not affect the operation of the independent channel under BDB event conditions, and the electrical functional performance of each level measurement channel would be considered independent of the other channel. This independence would result in a reliable SFP level measurement. However, the NRC staff plans to review the final electrical power supply design information to complete its review. The NRC staff has identified this request as:

RAI #18

Please provide the NRC staff with the final configuration of the power supply source for each channel so that the staff may conclude that the two channels are independent from a power supply assignment perspective.

<u>McGuire Response to RAI #18:</u>

The primary level channel electronics sensor and associated power control cabinet are located on the 767' Elevation of the Seismic Category I Auxiliary Building. The power control cabinet provides the normal and back-up battery power supply, and is located adjacent to the sensor. The normal power supply is to be provided by non-essential 120

VAC panel boards located on the 750' and 767' Elevations (Unit 2 and 1, respectively) of the Auxiliary Building.

The planned routing for the primary level channel cabling is depicted in Figures 1-4 and Figures 5-8 for Units 1 and 2, respectively. Figures 2 and 7 depict the relative proximity of the back-up channel components to the primary channel components.

As noted in the prior July 11, 2013 McGuire RAI response, the back-up channel is purely a mechanical pressure gauge device which is remotely located from any of the primary channel components and cabling. The back-up channel sense-line tubing is routed through the Reactor Building annulus area (725' floor elevation) to the read-out display/gauge in the Auxiliary Building (733' floor elevation). The back-up channel does not require power/signal cables or any power supply. The back-up channel components are spatially separated from the primary channel components/cabling by Seismic Category I structure floors and walls. The design of the back-up level channel is spatially separate and electrically independent from the primary channel, whereby potential common mode failures are precluded.

The primary level channel is readily afforded power supply and electrical independence from the back-up channel, due to the fact that the back-up channel requires no power or signal cable.

3.8 Design Features: Power Supplies

Attachment 2 of Order EA-12-051, states in part, that

> Permanently installed instrumentation channels shall each be powered by a separate power supply. Permanently installed and portable instrumentation channels shall provide for power connections from sources independent of the plant ac and dc power distribution systems, such as portable generators or replaceable batteries. Onsite generators used as an alternate power source and replaceable batteries used for instrument channel power shall have sufficient capacity to maintain the level indication function until offsite resource availability is reasonably assured.

NEI 12-02 states, in part, that

> The normal electrical power supply for each channel shall be provided by different sources such that the loss of one of the channels primary power supply will not result in a loss of power supply function to both channels of SFP level instrumentation.
>
> All channels of SFP level instrumentation shall provide the capability of connecting the channel to a source of power (e.g., portable generators or replaceable batteries) independent of the normal plant AC and DC power systems. For fixed channels this alternate capability shall include the ability to isolate the installed channel from its normal power supply or supplies. The portable power sources for the portable and installed channels shall be stored at separate locations, consistent with the reasonable protection requirements associated with NEI 12-06 (Order EA-12-049). The portable generator or replaceable batteries should be accessible and have sufficient capacity to support

reliable instrument channel operation until off-site resources can be deployed by the mitigating strategies resulting from Order EA-12-049.

If adequate power supply for either an installed or portable level instrument credits intermittent operation, then the provisions shall be made for quickly and reliably taking the channel out of service and restoring it to service. For example, a switch on the power supply to the channel is adequate provided the power can be periodically interrupted without significantly affecting the accuracy and reliability of the instrument reading. Continuous indication of SFP level is acceptable only if the power for such indication is demonstrably adequate for the time duration specified in section 3.1[.]

In its OIP, the licensee stated, in part, that

Power supplies (if required) for each SFP instrument/channel shall be electrically separate. If powered, the level instrumentation shall have provisions for emergency back-up power source such as batteries, which are rechargeable or replaceable. The back-up power source(s) must have sufficient capacity to maintain the level indication function until offsite power or other offsite emergency resources provided by FLEX procedures becomes available, consistent with the guidance of NEI 12-02.

In its letter dated July 11, 2013, the licensee stated that the primary channel would have battery back-up capacity and that because the secondary channel is a mechanical pressure gauge, it would not require power or battery back-up. In addition, the licensee stated, in part, that

The primary SFP level channel dedicated battery capacity is based on ability of the sensor to supply full load (20 mA) for the duration specified in the plant FLEX mitigation strategy with built-in safety margin. The battery capacity will be verified by analyses, and/or test prior to installation. The preliminary estimate of battery capacity is expected to be at approximately 6-7 days. It is estimated that a minimum battery capacity of 72 hours is required to align with the FLEX mitigation plan. If required, battery replacement provisions will be included in the FLEX Phase III strategy to provide continued SFP level monitoring capability.

The NRC staff notes that the proposed criteria for sizing of the battery backup appears to be consistent with NEI 12-02, as endorsed by the ISG. However, the staff plans to verify the results of the licensee's calculation for required duty cycle given the final design load of the instrument channel for its installed configuration. The staff has identified this request as:

RAI #19

Please provide the results of the calculation depicting the battery backup duty cycle requirements demonstrating that its capacity is sufficient to maintain the level indication function until offsite resource availability is reasonably assured.

McGuire Response to RAI #19:

Vendor analyses supports the battery capacity (at 20mA continuous discharge) can support ~130 hours and ~230 hours at -22°F and 32°F, respectively.

The calculated battery backup times above demonstrate that the backup battery has sufficient capacity to support reliable instrument channel operation until off-site resources can be deployed by the mitigating strategies in response to Order EA-12-049.

The required battery back-up capacity duration will further be demonstrated during post-modification testing.

3.9 Design Features: Accuracy

Attachment 2 of Order EA-12-051 states, in part, that

The instrument channels shall maintain their designed accuracy following a power interruption or change in power source without recalibration.

NEI 12-02 states, in part, that

Accuracy should consider operations while under SFP conditions, e.g., saturated water, steam environment, or concentrated borated water. Additionally, instrument accuracy should be sufficient to allow trained personnel to determine when the actual level exceeds the specified lower level of each indicating range (levels 1, 2 and 3) without conflicting or ambiguous indication.

In its OIP, the licensee stated that the new SFP level instrumentation will be designed to maintain their design accuracy without recalibration following a power interruption or change in power source.

In its letter dated July 11, 2013, the licensee stated, in part, that

The manufacturer reference accuracy for the primary SFP level channel is no greater than ±1 inch based on tests performed by AREVA. This is the design accuracy value that will be specified for the primary SFP level instrument channel. This value is subject to change dependent on the actual performance with the installed waveguide.

The accuracy of the primary SFP level channel is minimally affected by postulated BDB conditions (i.e., radiation, temperature, humidity, post-seismic and post shock conditions). The stainless steel horn antenna and waveguide pipe that is exposed to BDB conditions is unaffected by radiation, temperature and humidity other than a minor effect of condensation forming on the waveguide inner walls that will have a slight slowing effect on the radar pulse velocity. Condensation is prevented from pooling in the waveguide and thus blocking the radar signal by placement of weep holes at low points in the waveguide pipe. A minor effect on the accuracy is the length of the overall measurement path can change due to temperature related expansion of the waveguide pipe. The waveguide pipe permits the sensor electronics to be located in mild environment conditions so that the effect of elevated temperature on accuracy is also limited. Based on VEGA operating instructions for the VEGAPLILS 62ER, a small correction factor is applied to account for the impact of saturated steam at atmospheric pressure on the radar beam velocity. Testing performed by AREVA using saturated steam and saturated steam combined with smoke indicate that the overall effect on the instrument accuracy is minimal. The overall accuracy due to BDB conditions described above is estimated to not exceed ±3 inches.

The back-up SFP level channel is estimated have a total loop uncertainty of ± 7" for normal conditions and ± 14" for BDB conditions.

As part of the engineering change process, the overall level channel uncertainties will be formally documented by an instrument uncertainty calculation performed per Engineering Design Manual (EDM) 102.

Operational surveillance procedures will perform periodic channel checks for the primary and back-up SFP level instrumentation to verify proper operation. The acceptance criteria will consider the respective overall channel uncertainty contributions for accuracy, calibration setting tolerance, resolution, and drift (as applicable). The instrument uncertainty contributions will be considered to have random independent influences.

The NRC staff notes that the total loop uncertainty for the back-up SFP level channel is ± 14" during BDB conditions. The staff has concerns regarding calculation of this loop uncertainty. Further, the staff has concerns regarding capability of the back-up instrument to indicate SFP level when it exceeds the indicating range for the proposed Levels 2 and 3. The staff has identified these requests as:

RAI #20

Please provide the following:

a) **Results of the total loop uncertainty calculation for the back-up SFP level channel.**

b) **Explanation on how the back-up instrument would allow trained personnel to identify when the actual SFP level exceeds the specified Level 2 and 3. NEI 12-02, Section 2.3.2 and 2.3.3, states that level indication for Levels 2 and 3 (where BDB conditions can occur) should be with ± 1 foot uncertainty.**

McGuire Response to RAI #20 a):

The uncertainty calculation determined the SFP level channel total loop uncertainties during a postulated BDB/ELAP event to be as follows:

- <10" for the primary channel
- <12" for the back-up channel.

The results for both channels are included here-in, to clarify the estimated values previously provided in the McGuire July 11, 2013 RAI #11 response.

McGuire Response to RAI #20 b):

Section 3.7 of NEI 12-02 addresses instrument accuracy requirements and does not specify a required accuracy magnitude. The guidance provided in NEI 12-02 sections 2.3.2 and 2.3.3 is not specified as an "accuracy requirement," and is inconsistent with the depiction provided in Figure 1 of the guidance. Irrespective, the back-up level channel uncertainty effectively provides a nominal accuracy capability of ±1 foot.

The NRC staff plans to verify that the licensee's proposed instrument performance is consistent with these estimated accuracy values. Further, the NRC staff plans to verify that the channels will retain these accuracy performance values following a loss of power and subsequent restoration of power. The staff has identified this request as:

RAI #21

Please provide analysis verifying that the proposed instrument performance is consistent with these estimated accuracy normal and BDB values. Please demonstrate that the primary channel will retain these accuracy performance values following a loss of power and subsequent restoration of power.

McGuire Response to RAI #21:

The sensor, PLICSCOM display, power control panel, horn end of the waveguide, standard pool end and sensor end mounting brackets, and waveguide piping were successfully seismically tested in accordance with the requirements of the IEEE Standard 344-2004. The system was monitored for operability before and after the resonance search and seismic tests. The required response spectra used for the five Operating Basis Earthquakes (OBE) and one Safe Shutdown Earthquake (SSE) in the test were taken from EPRI TR-107330 Figure 4-5. This test level exceeds the building response spectra where equipment will be located.

The factory acceptance testing demonstrated acceptable accuracy and performance capability. The factory acceptance testing was performed utilizing a reflective target for the following conditions:

- normal operating conditions,
- simulated loss of normal AC power and automatic transfer to battery back-up power,
- simulated BDB conditions with steam injection into the radar horn,
- simulated BDB conditions water introduction into the radar horn and wave guided pipe.

For each of the test conditions the level instrumentation was capable of meeting the design accuracy performance specifications.

Vendor qualification testing further demonstrated acceptable accuracy performance when exposed to ambient steam conditions.

3.10 Design Features: Testing

Attachment 2 of Order EA-12-051 states, in part, that

> The instrument channel design shall provide for routine testing and calibration.

NEI 12-02 states, in part, that

> Static or non-active installed (fixed) sensors can be used and should be designed such that testing and/or calibration can be performed in-situ. For microprocessor based channels the instrument channel design shall be capable of testing while mounted in the pool.

In its OIP, the licensee stated that the instrument channel design would provide for routine testing and calibration, and testing would be consistent with the guidelines of NRC JLD-ISG-2012-03 and NEI 12-02.

In its letter dated July 11, 2013, the licensee stated, in part, that

> The primary SFP level channel has multi-point testing capability, in-that the radar horn antenna can be rotated away from the SFP water surface and aimed at a movable metal target that is positioned at known distances from the horn. This allows checking for correct readings at various points across the instrument measurement range and validates the functionality of the installed system.
>
> The back-up SFP level channel design readily supports periodic calibration across its monitoring range. The instrument is to be equipped with a calibration test tee and can be isolated from the process for routine calibrations.

Additionally, in its letter dated July 11, 2013, the licensee stated, in part, that

> The channel checks will be accomplished by comparison between the wide-range channel indications, or by comparison to the narrow range SFP level indication and/or known SFP physical level elevation reference markings.

The NRC staff notes that by comparing the levels in the instrument channels and the maximum level allowed deviation for the instrument channel design accuracy, the operators could determine if recalibration or troubleshooting is needed. Also, the staff notes that the licensee's proposed design, with respect to routine in-situ instrument channel functional and calibration tests, appears to be consistent with NEI 12-02, as endorsed by the ISG.

3.11 Design Features: Display

Attachment 2 of Order EA-12-051 states, in part, that

> Trained personnel shall be able to monitor the spent fuel pool water level from the control room, alternate shutdown panel, or other appropriate and accessible location.

> The display shall provide on-demand or continuous indication of spent fuel pool water level.

NEI 12-02 states, in part, that

> The intent of this guidance is to ensure that information on SFP level is reasonably available to the plant staff and decision makers. Ideally there will be an indication from at least one channel of instrumentation in the control room. While it is generally recognized (as demonstrated by the events at Fukushima Daiichi) that SFP level will not change rapidly during a loss of spent fuel pool cooling scenario more rapid SFP drain down cannot be entirely discounted. Therefore, the fact that plant personnel are able to determine the SFP level will satisfy this requirement, provided the personnel are available and trained in the use of the SFP level instrumentation (see Section 4.1) and that they can accomplish the task when required without unreasonable delay.
>
> SFP level indication from the installed channel shall be displayed in the control room, at the alternate shutdown panel, or another appropriate and accessible location (reference NEI 12-06). An appropriate and accessible location shall have the following characteristics:
>
> - occupied or promptly accessible to the appropriate plant staff giving appropriate consideration to various drain down scenarios,
> - outside of the area surrounding the SFP floor, e.g., an appropriate distance from the radiological sources resulting from an event impacting the SFP,
> - inside a structure providing protection against adverse weather, and
> - outside of any very high radiation areas or LOCKED HIGH RAD AREA during normal operation.
>
> If multiple display locations beyond the required "appropriate and accessible location" are desired, then the instrument channel shall be designed with the capability to drive the multiple display locations without impacting the primary "appropriate and accessible" display.

In its OIP, the licensee stated that the instrument displays for each SFP level instrument will be provided in the main control room or other accessible location.

In its letter dated July 11, 2013, the licensee stated, in part, that

> The primary SFP level channel has a local display on the Auxiliary Building on 767' Elevation, and in the main control room.
>
> The back-up SFP level channel display read-out is in an accessible location in the Auxiliary Building on 733' Elevation. The location is in the electrical penetration room, which is adjacent to the "B" train essential switchgear room.
>
> The back-up SFP channel display is located outside of the main control room and remote from the SFP area. The display location is located outside of any locked high radiation areas, and is accessible by operations personnel during postulated BDB event. The back-up level channel read-out displays are located in Seismic Category I structures, which are protected from potential threats posed by external natural

> phenomena events, such as flooding, seismic and tornado missiles. Personnel access to the display location relies upon the stairwells which provide access the Auxiliary Feedwater Pump Rooms and Auxiliary Shutdown Panels. During a postulated Extended Loss of AC Power (ELAP) event ambient temperatures at this location would be not be expected to prohibit periodic personnel access to monitor SFP levels. Formal analyses in support of the FLEX strategy will be completed to validate that area room temperatures will support personnel access. The estimated time for personnel to access the back-up channel display is 10-15 minutes, after personnel dispatch. The location of the back-up display is in close proximity to the vital battery and essential switchgear rooms, areas to which Operations personnel would potentially be dispatched as part of the FLEX strategy. Personnel accessing this area would rely on portable hand-held lighting, and hand-held radio communication with the main control room, and/or SFP inventory replenishment personnel. Based on the foregoing discussion, this location is considered to be promptly accessible for the purposes of monitoring SFP level during a postulated BDB event.

Additionally, in its letter dated July 11, 2013, the licensee stated, in part, that

> The primary SFP level display is located within the continuously occupied main control room. The estimated time for personnel to access the back-up SFP level display is 10-15 minutes, after personnel dispatch. The location of the back-up SFP level display is in close proximity to the vital battery and essential switchgear rooms, in which Operations personnel would potentially be dispatched as part of the FLEX strategy.

The NRC staff notes that the NEI guidance for "Display" specifically mentions the control room as an acceptable location for SFP instrumentation displays as it is occupied or promptly accessible, outside the area surrounding the SFP, inside a structure providing protection against adverse weather and outside of any very high radiation areas or LOCKED HIGH RAD AREA during normal operation. The licensee's proposed location for the primary SFP level instrumentation displays appears to be consistent with NEI 12-02, as endorsed by the ISG. However, the staff notes that for the back-up display location the licensee stated that event ambient temperature would not be expected to prohibit periodic personnel access to monitor SFP levels and that formal analyses will be completed to validate that area room temperatures will support personnel access. The staff plans to review the results of this analyses when completed. Additionally, the staff has concerns with the licensee's lack of information regarding the SFP level instrumentation display location. The staff has identified this request as:

RAI #22

For the back-up SFP level instrumentation displays location, please describe the evaluation used to validate that the display location can be accessed without unreasonable delay following a BDB event. Include the time available for personnel to access the display as credited in the evaluation, as well as the actual time (e.g., based on walk-throughs) that it will take for personnel to access the display. Additionally, please include a description of the radiological and environmental conditions on the paths personnel might take. Describe whether the display location remains habitable for radiological, heat and humidity, and other environmental conditions following a BDB event. Describe whether personnel are continuously stationed at the display or monitor the display periodically.

McGuire Response to RAI #22:

EA-12-051, the associated ISG, and NEI 12-02 guidance do not explicitly require a formal evaluation to determine the required time for personnel to access the SFP level display. NEI 12-02 section 3.1 allows reliance on portable SFP level instrumentation for the back-up channel, provided two trained personnel can deploy the instrument within 30 minutes. Personnel access to the proposed McGuire back-up SFP level channel can readily be achieved within this timeframe during a postulated BDB/ELAP event. As stated in the McGuire July 11, 2013 RAI response, personnel access to the back-up level instrument display was expected within 10-15 minutes of dispatch. This estimated deployment time was initially based on engineering judgment, and has subsequently been validated in the field. The field validation readily demonstrated the time for personnel deployment to the back-up level channel could be accomplished within ~5 minutes.

During a postulated event, only periodic personnel monitoring would be required for the back-up SFP level gauge. Personnel access to the back-up gage during a postulated ELAP event is considered to be readily accessible as defined by NEI 12-02 based on the following considerations:

- The travel path to the back-up SFP level display and the display location is confined within a Seismic Category I structure. The travel path is not exposed to potentially adverse SFP area conditions, and is protected from external events and adverse weather.
- The travel path to the back-up SFP level display and the display location do not require entry to a locked high-radiation area, and the associated area dose-rates would not prohibit personnel access.
- Analyses supports room temperatures for the back-up level display location will not exceed 110°F during the first 7 days with-out mitigating cooling actions.
- Analyses supports room temperatures along the travel path to the back-up level display will not exceed 120°F during the first 7 days with-out mitigating cooling actions.
- Humidity levels are conservatively assumed to approach 100% RH and would not prohibit periodic personnel access.

3.12 Programmatic Controls: Training

Attachment 2 of Order EA-12-051 states, in part, that

Personnel shall be trained in the use and the provision of alternate power to the primary and backup instrument channels.

NEI 12-02 states, in part, that

> The personnel performing functions associated with these SFP level instrumentation channels shall be trained to perform the job specific functions necessary for their assigned tasks (maintenance, calibration, surveillance, etc.). SFP instrumentation should be installed via the normal modification processes. In some cases, utilities may choose to utilize portable instrumentation as a portion of their SFP instrumentation response. In either case utilities should use the Systematic Approach to Training (SAT) to identify the population to be trained. The SAT process should also determine both the initial and continuing elements of the required training.

In its OIP, the licensee stated, in part, that

> The Systematic Approach to Training (SAT) will be used to identify the population to be trained and to determine both the initial and continuing elements of the required training. Training will be completed prior to placing the instrumentation in service.

The licensee's proposed plan, with respect to the training personnel in the use and the provision of alternate power to the primary and backup instrument channels, including the approach to identifying the population to be trained, appears to be consistent with NEI 12-02, as endorsed by the ISG.

3.13 Programmatic Controls: Procedures

Attachment 2 of Order EA-12-051 states, in part, that

> Procedures shall be established and maintained for the testing, calibration, and use of the primary and backup spent fuel pool instrument channels.

NEI 12-02 states, in part, that

> Procedures will be developed using guidelines and vendor instructions to address the maintenance, operation and abnormal response issues associated with the new SFP instrumentation.

In its OIP, the licensee stated that station procedures would be developed using guidelines and vendor instructions to address the maintenance, operation and abnormal response issues associated with the SFP level instrumentation. In addition, the licensee stated that procedures would be developed to address strategy to ensure SFP water addition is initiated at an appropriate time.

In its letter dated July 11, 2013, the licensee stated, in part, that

> A new Selected Licensee Commitment (SLC) will be established for the primary and back-up SFP level channels. The new SLC will specify the required frequency of performance for periodic channel checks, functional checks, and calibrations, as appropriate. The SLC will outline allowed out of service timeframes consistent with NEI 12-02 requirements. The SLC will specify required remedial actions, in-the-event one or more channels cannot be restored operable within the allowed out of service time-frame. The remedial actions will be consistent with NEI 12-02 requirements. Allowed channel out of service timeframes will be tracked by the Technical Specification Action Item Log (TSAIL) program in accordance with Operations Management Procedure 5-3.

Operational surveillances will be established to periodically verify proper level channel operation, which will consist of periodic primary and back-up SFP level channel checks as described in the response to RAI #7 b). Operations Management Procedure (OMP) 5-3 (Operations Periodic Test Program) governs the requirements for scheduling, reviewing and evaluation of periodic operational tests. The OMP requires unacceptable test results to be documented within the Corrective Action Program (Nuclear Station Directive 208).

Preventive maintenance tasks will be established in accordance with Nuclear Station Directive 411, which governs the Preventive Maintenance program bases, task planning and scheduling, execution, feedback, and change process. The preventive maintenance tasks will entail periodic level channel calibration, and functional checks as described in the response to RAI #8 c).

Subsequent to the performance of maintenance activities, post maintenance testing will be performed to ensure the SFP level instrumentation is properly functioning prior to return to service. Work Process Manual 501 and Nuclear Station Directive 408 govern the station requirements for testing.

FLEX Support Guides (FSGs), Emergency and/or Abnormal operating procedures will incorporate use of the primary and back-up SFP level instrumentation for monitoring/maintaining SFP inventory for BDB events, as appropriate.

The NRC staff notes that a new Selected Licensee Commitment (SLC) will be established and that further information with regard to testing, calibration and compensatory actions is still in development. The staff has identified this request as:

RAI #23

Please provide a list of the procedures addressing operation (both normal and abnormal response), calibration, test, maintenance, and inspection procedures that will be developed for use of the spent SFP instrumentation. The licensee is requested to include a brief description of the specific technical objectives to be achieved within each procedure.

McGuire Response to RAI #23:

In concert with the engineering change process, the planned station procedures include the following:

- Existing steps within Emergency and Abnormal Procedures will be modified to allow monitoring of SFP level via the primary and/or back-up SFP level channels. Procedures include the following:
    - ECA 0.0 (Loss of All AC Power)
    - G-1 (Generic Enclosures) (This EP is referenced from other Emergency and Abnormal procedures.)
    - AP/24 (Loss of Plant Control Due to Fire or Sabotage).

  - Flex Support Guide (FSG) for Alternate SFP Make-up and Cooling

- Operations surveillance procedure to periodically verify proper operation of the primary and back-up SFP level instrumentation. The procedure will perform periodic channel checks or comparisons between available SFP level instrumentation to verify proper operation of the primary and back-up SFP level instrumentation. This procedure will also serve to verify proper channel functionality within 60 days of a planned refueling outage, as required by NEI 12-02. The procedure is intended to provide a means of detection of channel drift and/or malfunction.

- Maintenance procedures for periodic calibration of the primary and back-up SFP level instrumentation and functional check of primary channel battery back-up capability. The procedure(s) will verify proper operation of the level instrumentation, and provide instruction for equipment calibration adjustment within design accuracy requirements.

3.14 Programmatic Controls: Testing and Calibration

Attachment 2 of Order EA-12-051 states, in part, that

> Processes shall be established and maintained for scheduling and implementing necessary testing and calibration of the primary and backup spent fuel pool level instrument channels to maintain the instrument channels at the design accuracy.

NEI 12-02 states, in part, that

> Processes shall be established and maintained for scheduling and implementing necessary testing and calibration of the primary and backup SFP level instrument channels to maintain the instrument channels at the design accuracy. The testing and calibration of the instrumentation shall be consistent with vendor recommendations or other documented basis.

In its OIP, the licensee stated, in part that

> Testing and calibration of the instrumentation will be consistent with vendor recommendations or other documented basis. Calibration will be specific to the mounted instrument(s) and the display(s).
>
> Station procedures and preventive maintenance will be developed to perform required instrumentation maintenance, testing, periodic calibrations, and/or functional checks.
>
> Existing station work control processes will be utilized to control maintenance and testing.

In its letter dated July 11, 2013, the licensee stated, in part, that

> Periodic channel checks will be established for the primary and back-up SFP level channels to verify proper instrument operation. The frequency of the channel checks is expected to be at least monthly (± 25% grace period). This frequency will readily satisfy NEI 12-02 (section 4.3) requirements to verify functionality 60 days prior to a planned refueling outage.
>
> Instrument channel calibration frequency will be based on the manufacture recommended frequency, and/or as established based on operating experience within the preventive maintenance program. As part of the periodic calibration surveillance for the primary SFP level channel, further functional verifications will be performed to verify proper operation of the battery backup feature on a simulated loss of normal AC power.
>
> The channel checks will be performed by Operations surveillance procedures, and the instrument calibrations will be performed by Maintenance instrumentation calibration surveillance procedures. Model work orders will be established within the periodic maintenance program to govern the scheduling and performance of the periodic calibrations.
>
> Routine preventive maintenance required during normal operation is limited to periodic channel calibration, and/or battery replacement (primary channel only).

Additionally, in its letter dated July 11, 2013, the licensee provided a list of the compensatory actions for single channel and both channels out of service beyond 90 days.

The NRC staff notes that a new SLC will be established and that further information with regard to testing, calibration and compensatory actions is still in development. The staff has identified this request as:

RAI #24

Please provide the following:

a) **Further information describing the testing and calibration program the licensee will establish and implement to ensure that regular testing and calibration is performed and verified by inspection and audit to demonstrate conformance with design and system readiness requirements. Please include a description of the plans for ensuring that necessary channel checks, functional tests, periodic calibration, and maintenance will be conducted for the level measurement system and its supporting equipment.**

b) **Information describing compensatory actions when both channels are out-of-order.**

c) **Additional information describing expedited and compensatory actions in the maintenance procedure to address when one of the instrument channels cannot be restored to functional status within 90 days.**

McGuire Response to RAI #24 a):

Programmatic controls will be established to ensure the performance of periodic channel checks, functional tests, calibration, and maintenance for the instrument channels. The programmatic controls will be established, in-part by a new Selected Licensee Commitment (SLC), as previously noted in the McGuire July 11, 2013, RAI #10 response:

> *"...A new Selected Licensee Commitment (SLC) will be established for the primary and back-up SFP level channels. The new SLC will specify the required frequency of performance for periodic channel checks, functional checks, and calibrations. as appropriate. The SLC will outline allowed out of service time-frames consistent with NEI 12-02 requirements. The SLC will specify required remedial actions, in the event one or more channels cannot be restored operable within the allowed out of service time-frame. The remedial actions will be consistent with NEI 12-02 requirements."*

The SLC will further require the functional testing be performed to verify proper channel operation within 60 days of a planned refueling outage, as required by NEI 12-02. This testing is expected to entail the performance of a channel check, and functional verification of the primary channel battery back-up capability. The channel out of service durations, required remedial actions and required action timeframes will be formally controlled similar to that for Technical Specifications.

The excerpted statement above from the McGuire July 11, 2013 RAI response is clarified here-in, in-that the SLC will not control the instrumentation calibration frequency. The calibration frequency will be controlled by the plant preventive maintenance program and will be based on manufacturer recommendations and/or operating experience.

McGuire Response to RAI #24 b):

The McGuire July 11, 2013 RAI #11 response previously outlined numerous potential compensatory actions which could be implemented in-the-event that both SFP level channels were out of service. As required by NEI 12-02, action(s) to restore at least one channel must be initiated within 24 hours, and compensatory actions must be implemented within 72 hours. The compensatory actions previously outlined are presented again below for the case in which both channels are out of service:

- Increased operator visual surveillance of the SFP level and area,
- Maintain elevated SFP level,
- Reduce SFP temperatures,
- Supplemental operations staffing,
- Pre-stage FLEX support equipment (nozzles, hoses, etc) which are relied upon for SFP make-up. Prestaged equipment would be located within Seismic Category I structures.

The listed compensatory actions were intended as examples of potential actions which could be considered (one or more), and is not intended to be a comprehensive listing. The corrective action program (CAP) would formally evaluate "functionality" for the SFP level channels and establish appropriate compensatory measures. The CAP would further establish appropriate procedural and process controls to ensure performance of any required compensatory measures.

McGuire Response to RAI #24 c):

The maintenance procedures will not explicitly address any expedited or compensatory actions for a channel that is not restored to functional within 90 days.

As required by NEI 12-02, compensatory actions must be implemented if one channel is not expected to be restored to functional within 90 days. The corrective action program will evaluate and establish appropriate compensatory actions for a channel that cannot be restored to functional within 90 days.

The McGuire July 11, 2013 RAI #11 response previously outlined numerous potential compensatory actions which could be implemented in-the-event one SFP level channel could not be restored to functional within 90 days. The compensatory actions previously outlined are presented again below for the case in which both channels are out of service:

- Increased surveillance (channel check) to verify functionality of the remaining operable level channel
- Implement equipment protective measures
- Increased operator visual surveillance of the SFP level and area,
- Maintain elevated SFP level,
- Reduce SFP temperatures,
- Supplemental operations staffing

The listed compensatory actions were intended as examples of potential actions which could be considered (one or more), and is not intended to be a comprehensive listing. The corrective action program (CAP) would formally evaluate "functionality" for the SFP level channels and establish appropriate compensatory measures. The CAP would further establish appropriate procedural and process controls to ensure performance of any required compensatory measures.

The NRC staff has concerns regarding the feasibility of the licensee's process for in-situ calibration to ensure that the design accuracy will be maintained. The staff has identified the following requests as:

RAI #25

Please provide a description of the in-situ calibration process at the SFP location that will result in the channel calibration being maintained at its design accuracy.

McGuire Response to RAI #25:

A response to this request was previously provided in the McGuire July 11, 2013 RAI #8 response:

"The primary SFP level channel has multi-point testing capability, in-that the radar horn antenna can be rotated away from the SFP water surface and aimed at a movable metal target that is positioned at known distances from the horn. This allows checking for correct readings at various points across the instrument measurement range and validates the functionality of the installed system.

> *The back-up SFP level channel design readily supports periodic calibration across its monitoring range. The instrument is to be equipped with a calibration test tee and can be isolated from the process for routine calibrations."*

The calibration procedures will verify proper operation of the level instrumentation, and provide instruction to facilitate adjustment of the equipment calibration within design accuracy requirements.

3.15 Instrument Reliability

NEI 12-02 states, in part, that

> A spent fuel pool level instrument channel is considered reliable when the instrument channel satisfies the design elements listed in Section 3 [Instrument Design Features] of this guidance and the plant operator has fully implemented the programmatic features listed in Section 4 [Program Features].

In its OIP, the licensee stated, in part

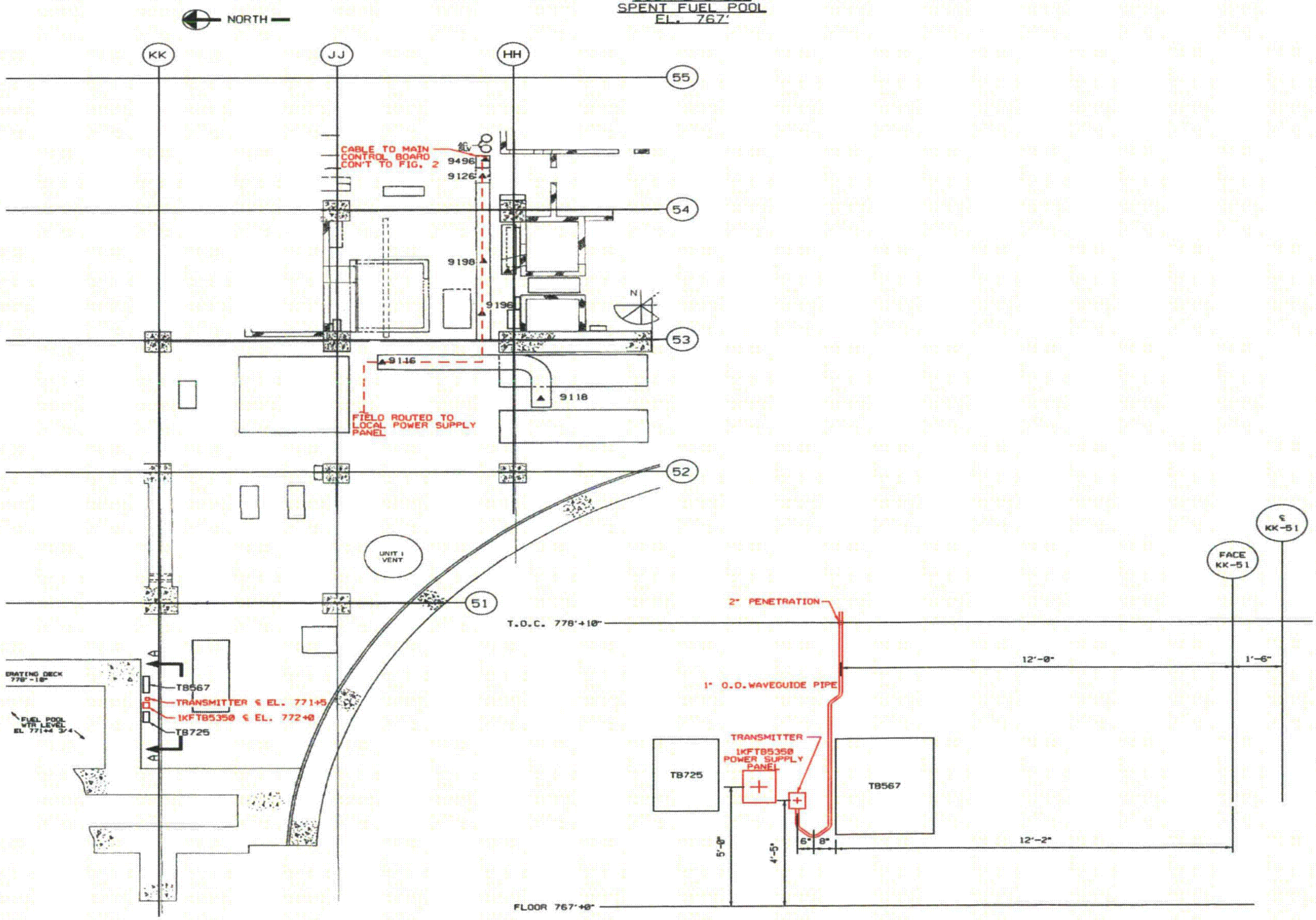
> Reliability of the level instrumentation will be assured by conformance with the guidelines of NRC JID-ISG-2012-03 and NEI 12-02, as described below.

Upon acceptable resolution of the RAIs noted above, the NRC staff will be able to make a conclusion regarding the reliability of the SFP instrumentation.

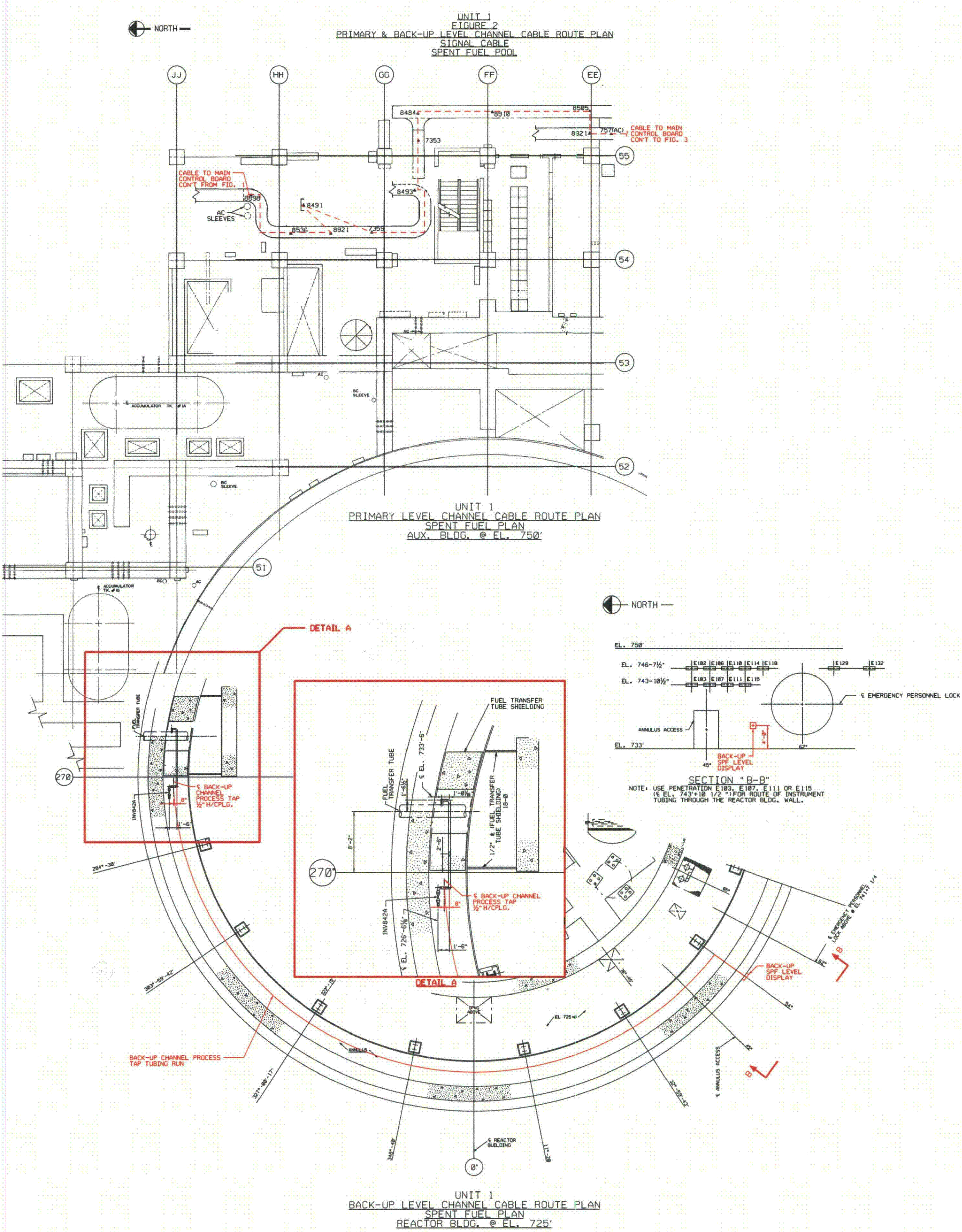
4.0 CONCLUSION

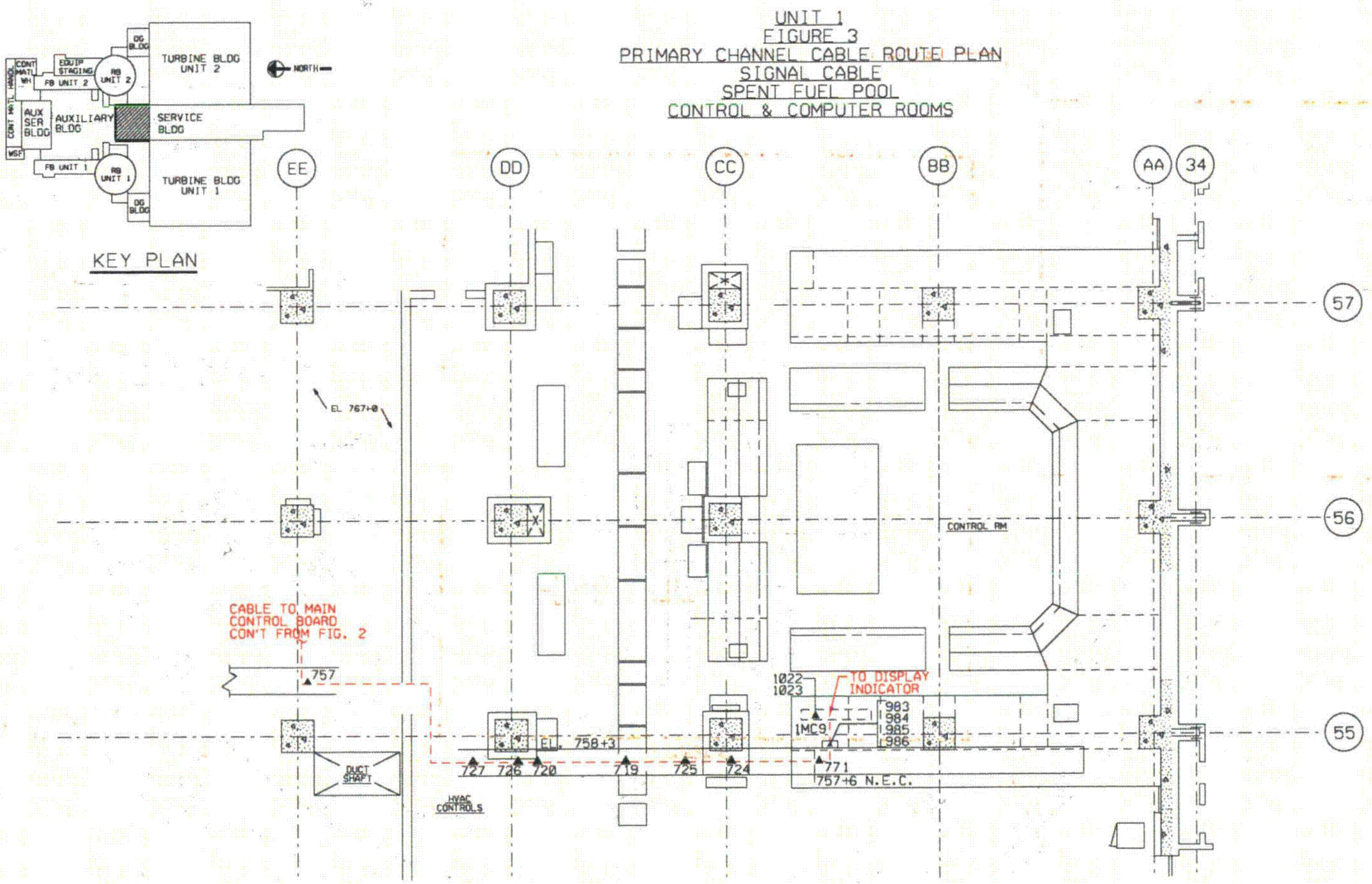
The NRC staff is unable to complete its evaluation regarding the acceptability of the licensee's plans for implementing the requirements of Order EA-12-051 due to the need for additional information as described above. The staff will issue an evaluation with its conclusion after the licensee has provided the requested information.

UNIT 1
FIGURE 1
PRIMARY LEVEL CHANNEL CABLE ROUTE PLAN
SIGNAL CABLE
SPENT FUEL POOL
EL. 767'

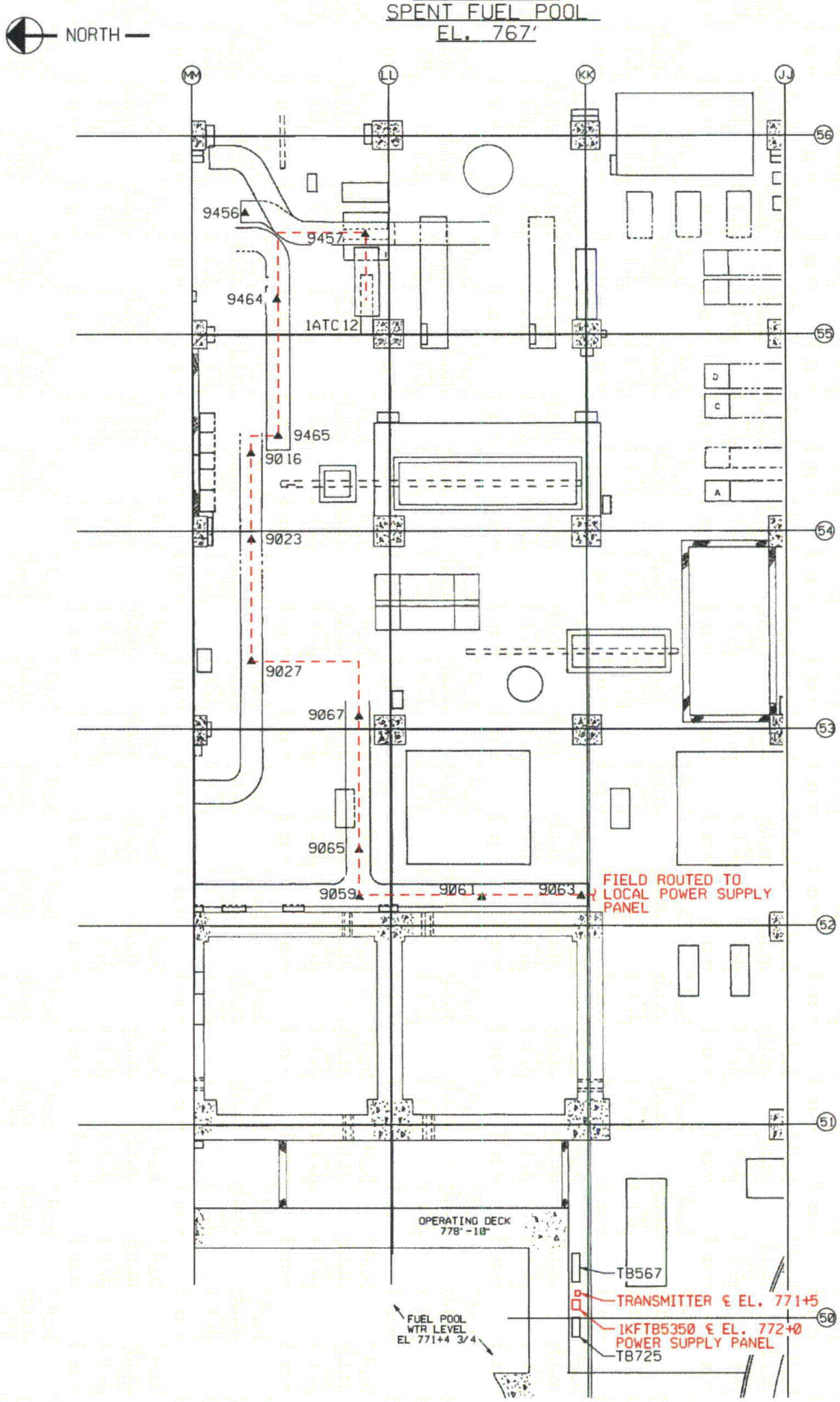


SECTION "A-A"
AUX. BLDG. 767'-0"

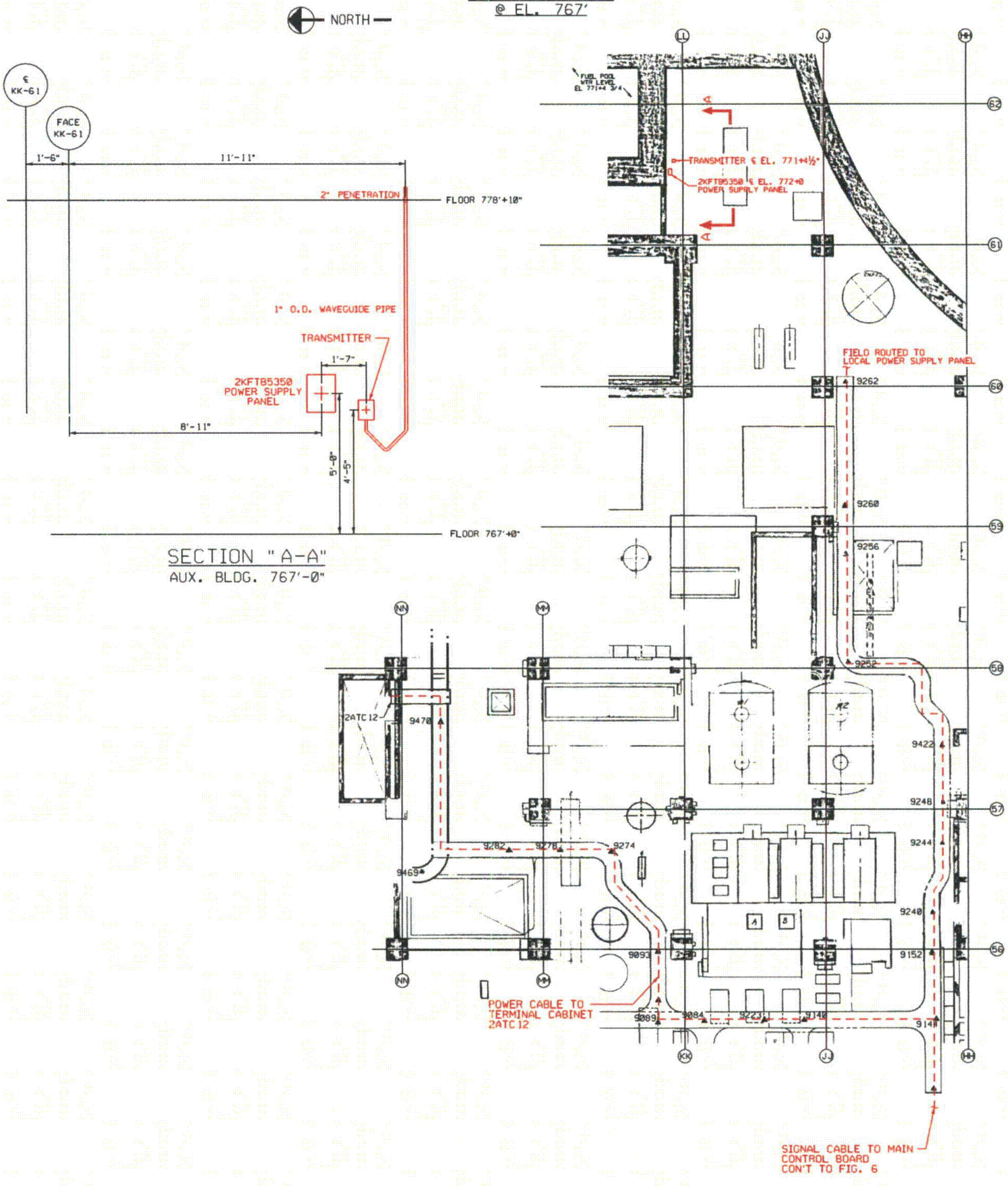

UNIT 1
FIGURE 2
PRIMARY & BACK-UP LEVEL CHANNEL CABLE ROUTE PLAN
SIGNAL CABLE
SPENT FUEL POOL
NORTH
JJ
HH
GG
FF
EE
55
54
53
52
51
CABLE TO MAIN CONTROL BOARD CON'T FROM FIG. 1
CABLE TO MAIN CONTROL BOARD CON'T TO FIG. 3
AC SLEEVES
8484
8910
8505
8921
757(AC)
7353
8493
8498
8491
8536
8921
7359
ACCUMULATOR TK. #1A
ACCUMULATOR TK. #1B
BC SLEEVE
UNIT 1
PRIMARY LEVEL CHANNEL CABLE ROUTE PLAN
SPENT FUEL PLAN
AUX. BLDG. @ EL. 750'
DETAIL A
FUEL TRANSFER TUBE SHIELDING
FUEL TRANSFER TUBE
℄ EL. 733'-6"
1'-6½"
1/2" ℄ (FUEL TRANSFER TUBE SHIELDING) 18-0
8'-2"
2'-6"
270
℄ BACK-UP CHANNEL PROCESS TAP ½" H/CPLG.
INV842A
℄ EL. 726'-6¼"
1'-6"
DETAIL A
BACK-UP CHANNEL PROCESS TAP TUBING RUN
℄ REACTOR BUILDING
0°
EL. 725
OPNG ABOVE
℄ ANNULUS ACCESS
BACK-UP SPF LEVEL DISPLAY
℄ EMERGENCY PERSONNEL LOCK ABOVE @ EL. 741+7 1/4
B
NORTH
EL. 750'
EL. 746-7½"
EL. 743-10½"
E102 E106 E110 E114 E118
E103 E107 E111 E115
E129
E132
℄ EMERGENCY PERSONNEL LOCK
ANNULUS ACCESS
EL. 733'
BACK-UP SPF LEVEL DISPLAY
SECTION "B-B"
NOTE: USE PENETRATION E103, E107, E111 OR E115 (℄ EL. 743'+10 1/2 ") FOR ROUTE OF INSTRUMENT TUBING THROUGH THE REACTOR BLDG. WALL.
UNIT 1
BACK-UP LEVEL CHANNEL CABLE ROUTE PLAN
SPENT FUEL PLAN
REACTOR BLDG. @ EL. 725'


UNIT 1
FIGURE 3
PRIMARY CHANNEL CABLE ROUTE PLAN
SIGNAL CABLE
SPENT FUEL POOL
CONTROL & COMPUTER ROOMS
KEY PLAN
TURBINE BLDG UNIT 2
TURBINE BLDG UNIT 1
AUXILIARY BLDG
SERVICE BLDG
NORTH
CABLE TO MAIN CONTROL BOARD CON'T FROM FIG. 2
TO DISPLAY INDICATOR
CONTROL RM
DUCT SHAFT
HVAC CONTROLS
EL 767+0
EL 758+3
757+6 N.E.C.
EE
DD
CC
BB
AA
34
57
56
55
757
727
726
720
719
725
724
771
1022
1023
1MC9
983
984
985
986

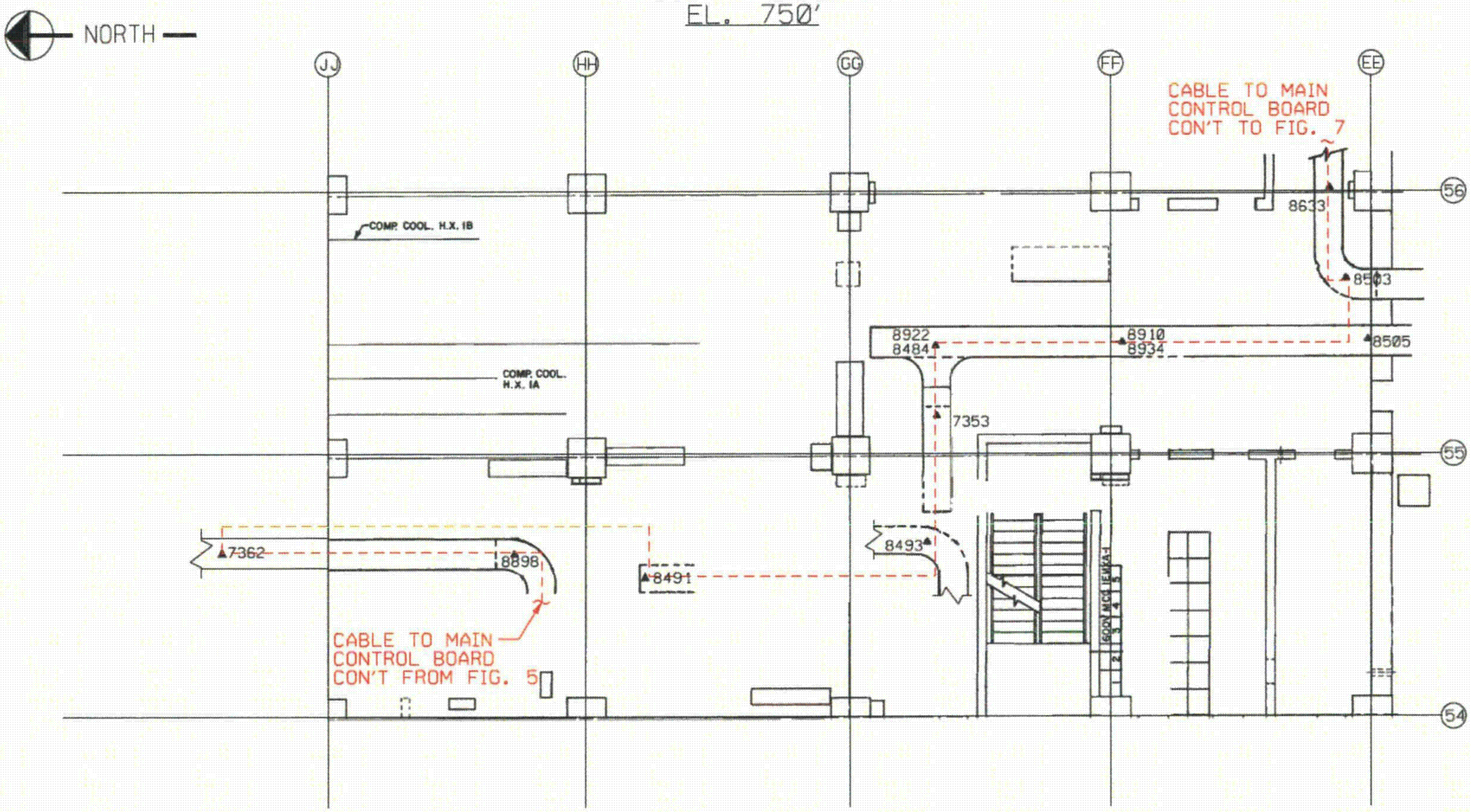
UNIT 1
FIGURE 4
PRIMARY LEVEL CHANNEL CABLE ROUTE PLAN
POWER CABLE
SPENT FUEL POOL
EL. 767'

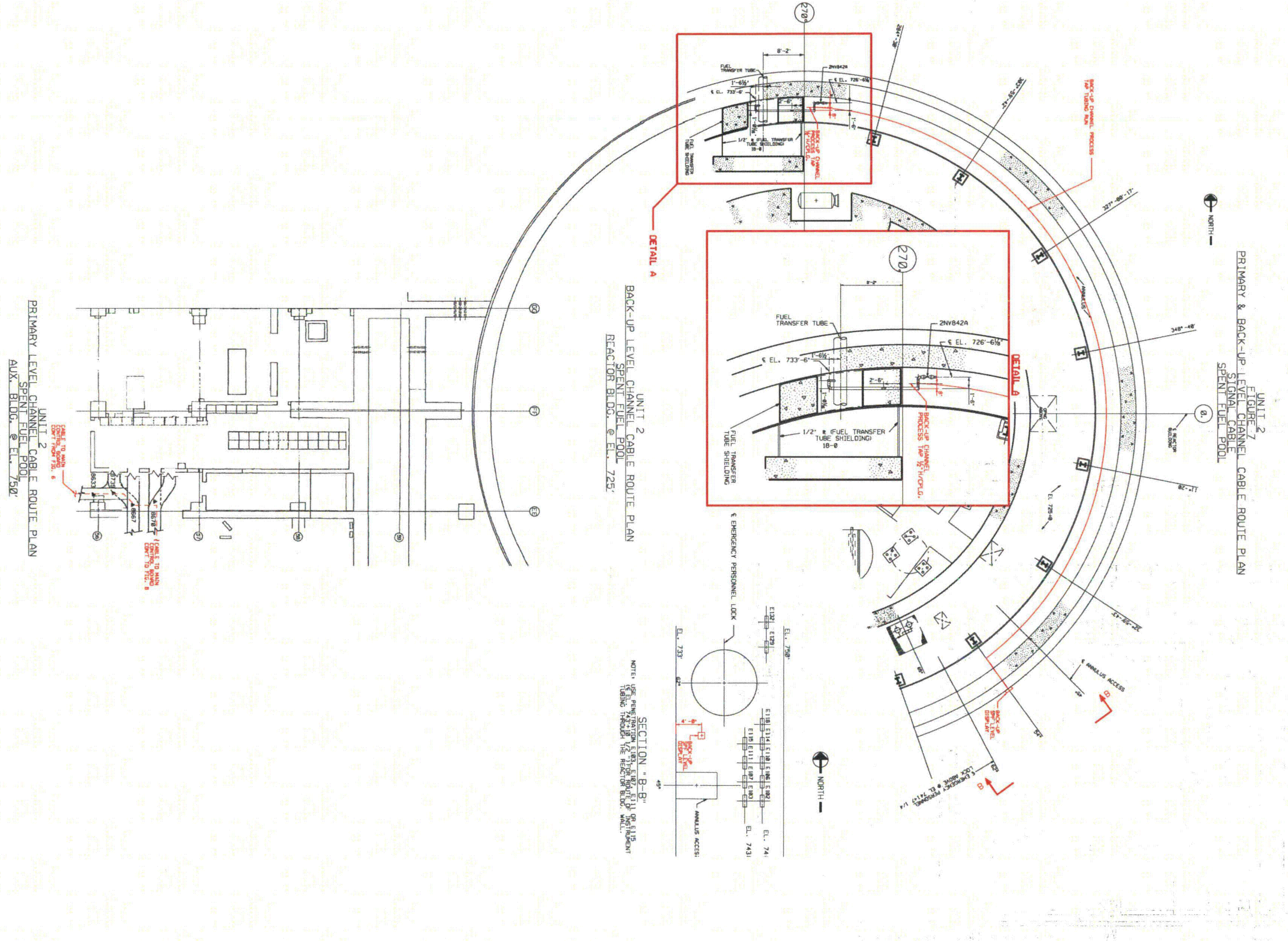


UNIT 2
FIGURE 5
PRIMARY LEVEL CHANNEL ROUTE PLAN
POWER AND SIGNAL CABLES
SPENT FUEL POOL
@ EL. 767'

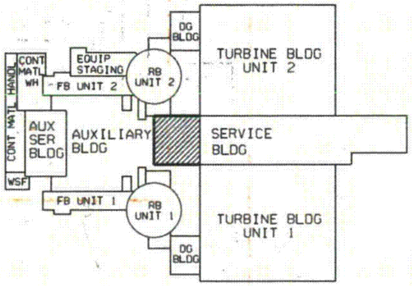


UNIT 2
FIGURE 6
PRIMARY LEVEL CHANNEL CABLE ROUTE PLAN
SIGNAL CABLE
SPENT FUEL POOL
EL. 750'



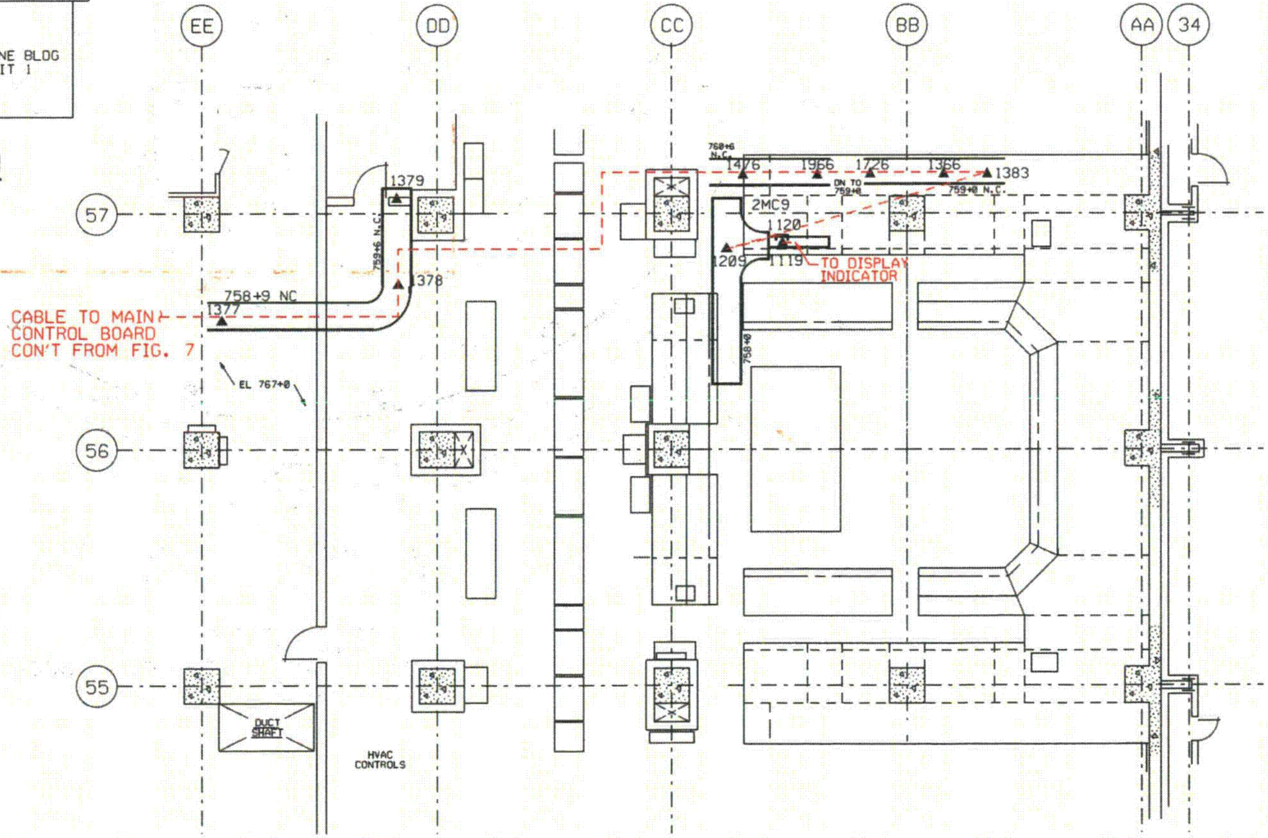

UNIT 2
FIGURE 7
PRIMARY & BACK-UP LEVEL CHANNEL CABLE ROUTE PLAN
SIGNAL CABLE
SPENT FUEL POOL
UNIT 2
BACK-UP LEVEL CHANNEL CABLE ROUTE PLAN
SPENT FUEL POOL
REACTOR BLDG. @ EL. 725'
UNIT 2
PRIMARY LEVEL CHANNEL CABLE ROUTE PLAN
SPENT FUEL POOL
AUX. BLDG. @ EL. 750'
DETAIL A
FUEL TRANSFER TUBE
2NY842A
1/2" ⌀ (FUEL TRANSFER TUBE SHIELDING) 18-0
FUEL TRANSFER TUBE SHIELDING
SECTION "B-B"
NORTH
EL. 733'
EL. 750'
ANNULUS ACCESS

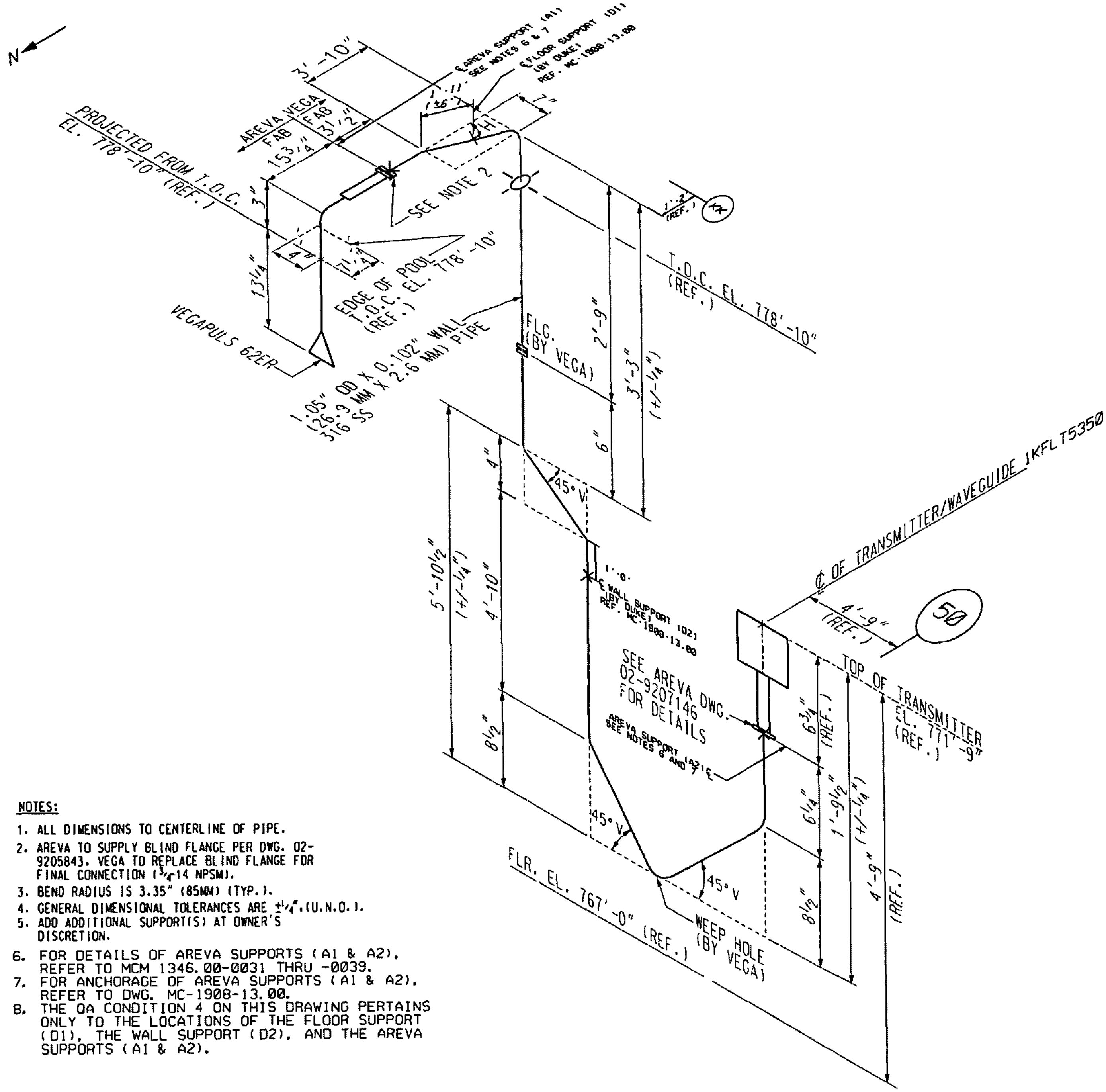
UNIT 2
FIGURE 8
PRIMARY CHANNEL CABLE ROUTE PLAN
SIGNAL CABLE
SPENT FUEL POOL
CONTROL & COMPUTER ROOMS



KEY PLAN

NORTH

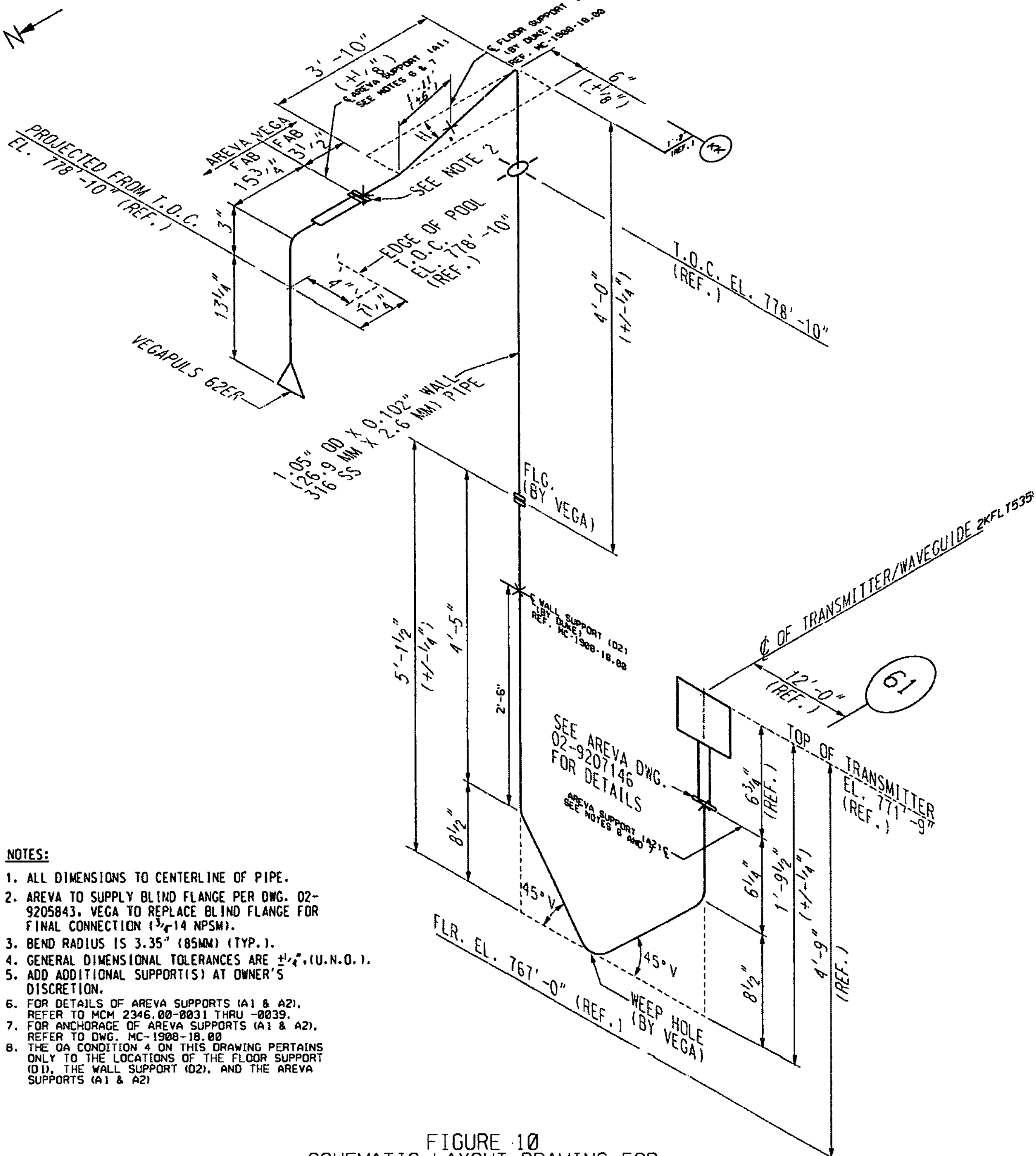




NOTES:

1. ALL DIMENSIONS TO CENTERLINE OF PIPE.
2. AREVA TO SUPPLY BLIND FLANGE PER DWG. 02-9205843. VEGA TO REPLACE BLIND FLANGE FOR FINAL CONNECTION (3/4"-14 NPSM).
3. BEND RADIUS IS 3.35" (85MM) (TYP.).
4. GENERAL DIMENSIONAL TOLERANCES ARE ±1/4". (U.N.O.).
5. ADD ADDITIONAL SUPPORT(S) AT OWNER'S DISCRETION.
6. FOR DETAILS OF AREVA SUPPORTS (A1 & A2), REFER TO MCM 1346.00-0031 THRU -0039.
7. FOR ANCHORAGE OF AREVA SUPPORTS (A1 & A2), REFER TO DWG. MC-1908-13.00.
8. THE QA CONDITION 4 ON THIS DRAWING PERTAINS ONLY TO THE LOCATIONS OF THE FLOOR SUPPORT (D1), THE WALL SUPPORT (D2), AND THE AREVA SUPPORTS (A1 & A2).

FIGURE 9
SCHEMATIC LAYOUT DRAWING FOR
MNS UNIT 1
VEGA WAVEGUIDE PIPE, TRANSMITTER,
VEGAPULS 62ER SENSOR, AND
MOUNTING SUPPORTS



NOTES:

1. ALL DIMENSIONS TO CENTERLINE OF PIPE.
2. AREVA TO SUPPLY BLIND FLANGE PER DWG. 02-9205843. VEGA TO REPLACE BLIND FLANGE FOR FINAL CONNECTION (3/4"-14 NPSM).
3. BEND RADIUS IS 3.35" (85MM) (TYP.).
4. GENERAL DIMENSIONAL TOLERANCES ARE ±1/4",(U.N.O.).
5. ADD ADDITIONAL SUPPORT(S) AT OWNER'S DISCRETION.
6. FOR DETAILS OF AREVA SUPPORTS (A1 & A2), REFER TO MCM 2346.00-0031 THRU -0039.
7. FOR ANCHORAGE OF AREVA SUPPORTS (A1 & A2), REFER TO DWG. MC-1908-18.00
8. THE QA CONDITION 4 ON THIS DRAWING PERTAINS ONLY TO THE LOCATIONS OF THE FLOOR SUPPORT (D1), THE WALL SUPPORT (D2), AND THE AREVA SUPPORTS (A1 & A2)

FIGURE 10
SCHEMATIC LAYOUT DRAWING FOR
MNS UNIT 2
VEGA WAVEGUIDE PIPE, TRANSMITTER,
VEGAPULS 62ER SENSOR, AND
MOUNTING SUPPORTS

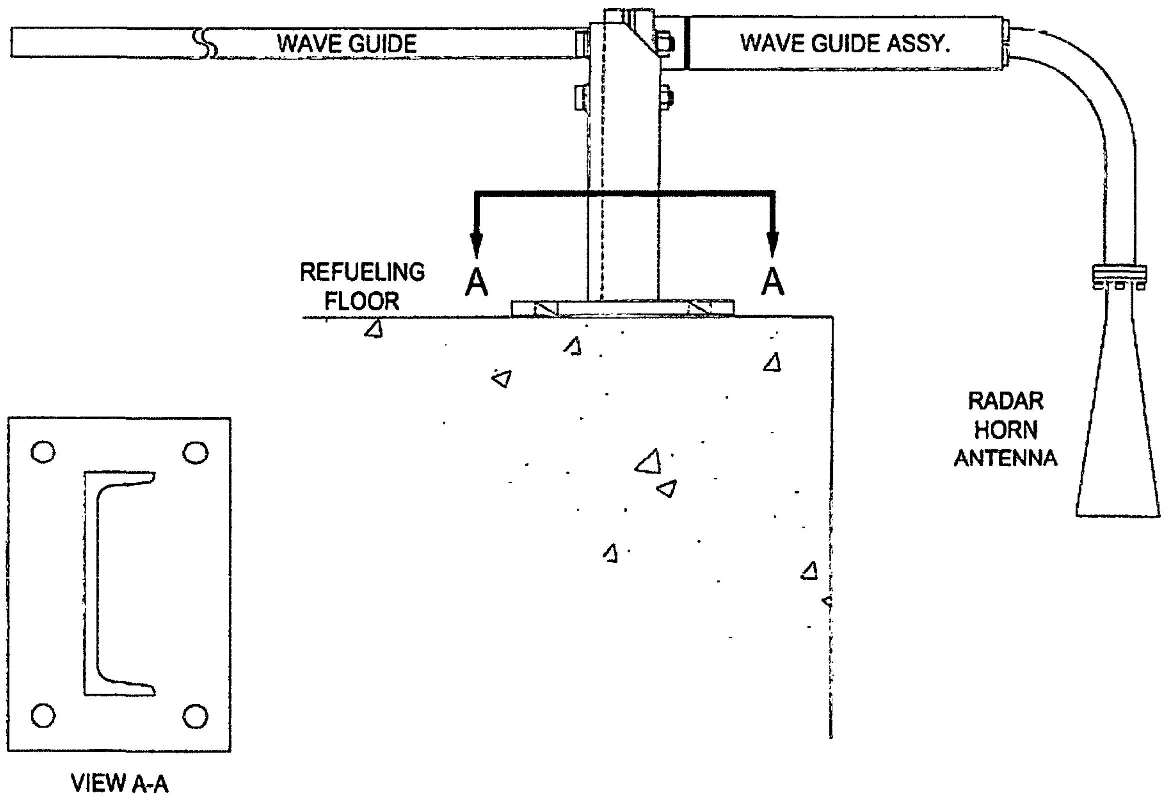


FIGURE 11 – Radar Horn Pool Edge Mounting Configuration