ArevaEPRDCPEm Resource

From: Pederson Ronda M (AREVA NP INC) [Ronda.Pederson@areva.com]
Sent: Thursday, May 07, 2009 5:05 PM
To: Getachew Tesfaye
Cc: BENNETT Kathy A (OFR) (AREVA NP INC); DELANO Karen V (AREVA NP INC); DUNCAN Leslie E (AREVA NP INC); KOWALSKI David J (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 163, FSAR Ch 9, Supplement 3
Attachments: RAI 163 Supplement 3 Response US EPR DC.pdf

Getachew,

AREVA NP Inc. provided responses to 1 of the 12 questions of RAI No. 163 on February 6, 2009. Supplement 1 response to RAI No. 163 was sent on March 20, 2009 to address 6 of the remaining questions. Supplement 2 response to RAI No. 163 was sent on April 3, 2009 to apprise the NRC of a revised schedule for the remaining 5 questions.

The attached file, “RAI 163 Supplement 3 Response US EPR DC.pdf” provides a technically correct and complete response to 4 of the 5 remaining questions, as committed.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which supports the response to RAI 163 Questions 09.03.03-2, 09.03.03-3 and 09.03.03-4.

The following table indicates the respective pages in the response document, “RAI 163 Supplement 3 Response US EPR DC.pdf,” that contain AREVA NP’s response to the subject questions.

Question #	Start Page	End Page
RAI 163 — 09.03.03-2	2	3
RAI 163 — 09.03.03-3	4	5
RAI 163 — 09.03.03-4	6	6
RAI 163 — 09.03.03-6	7	7

Since a response to the remaining question remains in process, a revised schedule is provided in this email.

The schedule for a technically correct and complete response to the remaining question has been changed as provided below:

Question #	Response Date
RAI 163 — 09.03.03-5	June 18, 2009

Sincerely,

Ronda Pederson
ronda.pederson@areva.com
Licensing Manager, U.S. EPR Design Certification
AREVA NP Inc.
An AREVA and Siemens company
3315 Old Forest Road
Lynchburg, VA 24506-0935
Phone: 434-832-3694
Cell: 434-841-8788

From: Pederson Ronda M (AREVA NP INC)
Sent: Friday, April 03, 2009 5:24 PM
To: Getachew Tesfaye
Cc: KOWALSKI David J (AREVA NP INC); DELANO Karen V (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 163, Supplement 2

Getachew,

AREVA NP is unable to provide responses to the remaining questions today, as previously committed.

The schedule for a technically correct and complete response to the remaining questions has been revised as provided below.

Question #	Response Date
RAI 163 — 09.03.03-2	May 7, 2009
RAI 163 — 09.03.03-3	May 7, 2009
RAI 163 — 09.03.03-4	May 7, 2009
RAI 163 — 09.03.03-5	May 7, 2009
RAI 163 — 09.03.03-6	May 7, 2009

Sincerely,

Ronda Pederson
ronda.pederson@areva.com
Licensing Manager, U.S. EPR Design Certification
AREVA NP Inc.
An AREVA and Siemens company
3315 Old Forest Road
Lynchburg, VA 24506-0935
Phone: 434-832-3694
Cell: 434-841-8788

From: Pederson Ronda M (AREVA NP INC)
Sent: Friday, March 20, 2009 6:26 PM
To: 'Getachew Tesfaye'
Cc: BENNETT Kathy A (OFR) (AREVA NP INC); DELANO Karen V (AREVA NP INC); KOWALSKI David J (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 163, Supplement 1

Getachew,

AREVA NP Inc. provided a response to 1 of the 12 questions of RAI No. 163 on February 6, 2009. The attached file, “RAI 163 Supplement 1 Response US EPR DC.pdf” provides technically correct and complete responses to 6 of the remaining 11 questions, as committed.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which support the response to RAI 163 Questions 09.02.02-1, 09.02.02-3, 09.02.02-4, 09.02.02-5 and 09.02.02-6.

The following table indicates the respective pages in the response document, “RAI 163 Supplement 1 Response US EPR DC.pdf,” that contain AREVA NP’s response to the subject questions.

Question #	Start Page	End Page
RAI 163 — 09.02.02-1	2	3
RAI 163 — 09.02.02-2	4	5
RAI 163 — 09.02.02-3	6	6
RAI 163 — 09.02.02-4	7	8
RAI 163 — 09.02.02-5	9	10
RAI 163 — 09.02.02-6	11	12

The schedule for a technically correct and complete response to the remaining questions is unchanged and provided below.

Question #	Response Date
RAI 163 — 09.03.03-2	April 3, 2009
RAI 163 — 09.03.03-3	April 3, 2009
RAI 163 — 09.03.03-4	April 3, 2009
RAI 163 — 09.03.03-5	April 3, 2009
RAI 163 — 09.03.03-6	April 3, 2009

Sincerely,

Ronda Pederson

ronda.pederson@areva.com
Licensing Manager, U.S. EPR Design Certification
AREVA NP Inc.
An AREVA and Siemens company
3315 Old Forest Road
Lynchburg, VA 24506-0935
Phone: 434-832-3694
Cell: 434-841-8788

From: WELLS Russell D (AREVA NP INC)
Sent: Friday, February 06, 2009 1:00 PM
To: 'Getachew Tesfaye'
Cc: Pederson Ronda M (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); DELANO Karen V (AREVA NP INC); SLIVA Dana (EXT)
Subject: Response to U.S. EPR Design Certification Application RAI No. 163, FSAR Ch 9

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 163 Response US EPR DC.pdf" provides a technically correct and complete response to 1 of the 12 questions.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which supports the response to RAI 163 Question 09.03.03-1.

The following table indicates the respective pages in the response document, "RAI 163 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 163 — 09.02.02-1	2	2

RAI 163 — 09.02.02-2	3	3
RAI 163 — 09.02.02-3	4	4
RAI 163 — 09.02.02-4	5	5
RAI 163 — 09.02.02-5	6	6
RAI 163 — 09.02.02-6	7	7
RAI 163 — 09.03.03-1	8	8
RAI 163 — 09.03.03-2	9	9
RAI 163 — 09.03.03-3	10	10
RAI 163 — 09.03.03-4	11	11
RAI 163 — 09.03.03-5	12	12
RAI 163 — 09.03.03-6	13	13

A complete answer is not provided for 11 of the 12 questions. The schedule for a technically correct and complete response to these questions is provided below.

Question #	Response Date
RAI 163 — 09.02.02-1	March 20, 2009
RAI 163 — 09.02.02-2	March 20, 2009
RAI 163 — 09.02.02-3	March 20, 2009
RAI 163 — 09.02.02-4	March 20, 2009
RAI 163 — 09.02.02-5	March 20, 2009
RAI 163 — 09.02.02-6	March 20, 2009
RAI 163 — 09.03.03-2	April 3, 2009
RAI 163 — 09.03.03-3	April 3, 2009
RAI 163 — 09.03.03-4	April 3, 2009
RAI 163 — 09.03.03-5	April 3, 2009
RAI 163 — 09.03.03-6	April 3, 2009

Sincerely,

(Russ Wells on behalf of)
Ronda Pederson

ronda.pederson@areva.com
Licensing Manager, U.S. EPR Design Certification
New Plants Deployment
AREVA NP, Inc.
An AREVA and Siemens company
3315 Old Forest Road
Lynchburg, VA 24506-0935
Phone: 434-832-3694
Cell: 434-841-8788

From: Getachew Tesfaye [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Friday, January 09, 2009 7:18 PM
To: ZZ-DL-A-USEPR-DL
Cc: Larry Wheeler; Peter Wilson; Chang Li; John Segala; Peter Hearn; Joseph Colaccino; John Rycyna; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 163 (1809, 1763),FSAR Ch. 9

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on December 23, 2008, and on January 6, 2009, you informed us that the RAI is clear and no further clarification is needed. As a result, no change is made to the draft RAI. The schedule we have established for review of your application assumes technically correct and complete responses within 30 days of receipt of RAIs. For any RAIs that cannot be answered within 30 days, it is expected that a date for receipt of this information will be provided to the staff within the 30 day period so that the staff can assess how this information will impact the published schedule.

Thanks,
Getachew Tesfaye
Sr. Project Manager
NRO/DNRL/NARP
(301) 415-3361

Hearing Identifier: AREVA_EPR_DC_RAIs
Email Number: 455

Mail Envelope Properties (5CEC4184E98FFE49A383961FAD402D31E38BD9)

Subject: Response to U.S. EPR Design Certification Application RAI No. 163, FSAR Ch 9, Supplement 3
Sent Date: 5/7/2009 5:04:34 PM
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From: Pederson Ronda M (AREVA NP INC)

Created By: Ronda.Pederson@areva.com

Recipients:
"BENNETT Kathy A (OFR) (AREVA NP INC)" <Kathy.Bennett@areva.com>
Tracking Status: None
"DELANO Karen V (AREVA NP INC)" <Karen.Delano@areva.com>
Tracking Status: None
"DUNCAN Leslie E (AREVA NP INC)" <Leslie.Duncan@areva.com>
Tracking Status: None
"KOWALSKI David J (AREVA NP INC)" <David.Kowalski@areva.com>
Tracking Status: None
"Getachew Tesfaye" <Getachew.Tesfaye@nrc.gov>
Tracking Status: None

Post Office: AUSLYNCMX02.adom.ad.corp

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MESSAGE	8400	5/7/2009 5:04:39 PM
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Sensitivity: Normal
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Response to

Request for Additional Information No. 163 (1809, 1763), Supplement 3, Revision 0

01/09/2009

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 09.02.02 - Reactor Auxiliary Cooling Water Systems
SRP Section: 09.03.03 - Equipment and Floor Drainage System

Application FSAR Ch. 9

QUESTIONS for Balance of Plant Branch 1 (AP1000/EPR Projects) (SBPA)
QUESTIONS for Balance of Plant Branch 2 (ESBWR/ABWR) (SBPB)

Question 09.03.03-2:

GDC 2 requires safety-related components to be protected against natural phenomena including earthquakes. The nuclear island drain and vent system (NIDVS) is considered non-safety related except for the containment isolation valves and piping.

SRP Section 9.3.3 Subsection III, Review Procedure 1.D states that if a failure of a portion of the system could affect safety-related structures, systems, or components (SSCs) adversely, it is safety-related and should meet GDC 2. The staff identified the following portions of the system that may be safety-related and subject to GDC 2 requirements:

1. sump pump level instrument in the safeguard building (SB) that provide isolation signal for SB essential service water system (ESWS) train.

   Because the NIDVS level sensors detect flooding and are credited for the thirty minute operator response to secure the source of flooding, a failure or malfunction in this portion of the system could adversely affect safety-related SSCs. A false high sump level could inadvertently render ESWS inoperable or a failure to detect a high level in the redundant level sensors could prevent the flood high level isolation of ESWS.

2. level instruments (in reactor building (RB), SB, and fuel building (FB) sumps) that are used to provide the main control room (MCR) flood alarms:

   These flood alarms notify the MCR operator to begin the operator action to isolate the line causing the flooding. The fire water line break defines the worst case flood analyses for the nuclear island (NI) buildings (RB, SB, and FB). It appears to the staff that a failure or malfunction in this portion of the system could adversely affect safety-related SSCs. A malfunction could prevent the flood level from remaining below the elevation assumed in the flood analysis.

Since the above components are credited to prevent flooding of safety-related equipment, the failure of the above components could adversely affect safety-related SSCs. Classify these components as being safety-related, or justify the nonsafety classification.

Response to Question 09.03.03-2:

1. In response to RAI 131, Supplement 1, Question 09.02.01-25, nuclear island drain/vent system (NIDVS) sump level instrumentation, located at the lowest level in the non-controlled areas of the Safeguard Buildings (SB), were upgraded to safety-related, Seismic Category I. This level instrumentation provides a signal to automatically isolate the essential service water system (ESWS) train in the affected SB during a flooding event.

   U.S. EPR FSAR, Tier 2, Sections 9.3.3.3 and 9.3.3.5 will be revised to further clarify the NIDVS sump level instrumentation.

2. The following NIDVS sumps have safety-related, Seismic Category I level instrumentation that annunciates in the Main Control Room (MCR) to notify operators of a flooding event, and to initiate operator action to isolate the worst-case flooding source (the fire water distribution system):

   - Reactor Building (RB) sump (1).

- RB annular space sump (1).
- SB sumps (4).
- Fuel Building (FB) sumps (2).

U.S. EPR FSAR, Tier 2, Sections 3.4.3.3 and 3.4.3.5 will be revised to further clarify the NIDVS sump level instrumentation.

FSAR Impact:

U.S. EPR FSAR, Tier 2, Sections 9.3.3.3, 9.3.3.5, 3.4.3.3, and 3.4.3.5 will be revised as described in the response and indicated on the enclosed markup.

Question 09.03.03-3:

GDC 4 acceptance is based on the system being able to prevent flooding that could adversely affect structures, systems, and components (SSCs) important to safety. SRP Section 9.3.3 Subsection II, “Acceptance Criteria,” Technical Rationale Number 2 clarifies the acceptance of GDC 4 for the equipment and floor drain system (EFDS). It states that for the EFDS (i.e., NIDVS for EPR), the purpose of GDC 4 is to assure the capability to provide the required drainage capability to accommodate unanticipated flooding from pipe breaks, tank leaks, discharge from fire suppression systems, and other potential flooding sources. Therefore, the drainage capability of the NIDVS for the flood protection should be addressed in the FSAR for NIDVS to meet GDC 4 criterion.

FSAR Tier 2 Section 9.3.3.3, “Safety Evaluation,” states that the design of safety-related portions of the NIDVS satisfy GDC 4 withstanding the effects of the environmental conditions (e.g., flooding) as demonstrated by the design features described in the section. The staff reviewed the above statement and the design features described in FSAR Tier 2 Section 9.3.3.3, and found that the applicant has not completely addressed the compliance of GDC 4 in accordance with SRP Section 9.3.3. Specifically, the drainage capability is not addressed for NIDVS in FSAR Section 9.3.3 or Section 9.3.3.3.

The staff found that FSAR Section 3.4.1, “Internal Flood Protection,” states that the NIDVS is conservatively considered not available for reducing water volume by the respective sump pumps. The staff verified whether the application of the above assumption has been consistently applied in the flood analysis and the design of NIDVS. In FSAR Section 3.4.3.1, the applicant discussed all the assumptions for the internal flood analysis, but the staff could not verify that the unavailability of drain flow capability is one of the assumptions for the flood analysis. In reviewing flood protection for main control room (MCR), the staff questioned in RAI 04.03.02-3 (RAI ID# 1525) that there will be adequate flood protection without taking credit of the floor drains in the MCR. Furthermore, in FSAR Section 9.3.3 and Section 9.3.3.3, the staff could not confirm that the unavailability of drain flow capability for the flood protection is one of the design bases for the NIDVS or one of the bases for GDC 4 being satisfied by the NIDVS.

Based on the inconsistencies identified above, the applicant is requested to (1) clarify the drainage capability that is assumed in the flood analysis, and to substantiate the assumption by calculations for flood analysis, which are not available in the FSAR. (2) Add the assumption for the drainage capability into the list of assumptions in FSAR Section 3.4.3.1 for flood analysis. Furthermore, (3) revise FSAR Section 9.3.3/Section 9.3.3.3 to address GDC 4 compliance in accordance with SRP Section 9.3.3 regarding drainage capability.

Response to Question 09.03.03-3:

Floor drains are not credited in the flooding analysis for protecting safety-related structures, systems and components (SSC) that are required for safe shutdown. The flooding analysis assumes the nuclear island drain/vent system (NIDVS) floor drains are plugged and the sump pumps are not available for water volume reduction during a flooding event. Large openings not susceptible to plugging including staircases, elevator shafts, equipment openings, and flooding pits with burst openings are credited as water flowpaths to direct flood water to the lower building levels. The unavailability of the NIDVS floor drains will be added as assumptions in U.S. EPR FSAR, Tier 2, Sections 3.4.1, 3.4.3.1, 3.4.3.4, and 9.3.3.3.

FSAR Impact:

U.S. EPR FSAR, Tier 2, Sections 3.4.1, 3.4.3.1, 3.4.3.4 and 9.3.3.3 will be revised as described in the response and indicated on the enclosed markup.

Question 09.03.03-4:

GDC 4 requires safety-related components to be protected against environmental conditions such as flooding. The staff reviewed the NIDVS check valves that prevent backflow of flooding water through the drain system into areas of the plant containing safety-related equipment. NIDVS piping between the two divisions of the fuel building (FB) and between safeguard buildings SB-1, SB-2, SB-3, and SB-4 rely upon double check valves to prevent back flow. The NIDVS piping in the nuclear auxiliary building (NAB) connects to safety-related equipment areas of the FB and SB. Following the review procedures described in SRP Section 9.3.3 Subsection III.1, and RG 1.29, Regulatory Position C.2, the staff found that failure of these nonsafety-related piping and check valves could affect the flood protection of safety-related SSCs. Therefore, the safety significance of these piping and check valves may justify increased attention to their reliability and ability to function following a seismic event.

Discuss the ability of these nonsafety-related piping and check valves to function following a seismic event, and the requirements of testing and inspection of these components to ensure the reliability of these components to be able to perform their intended function.

Response to Question 09.03.03-4:

Pump discharge lines from the nuclear island drain/vent system (NIDVS) in each of the Safeguard Buildings (SB), as well as the sumps from the Fuel Building (FB), are individually routed to their destination in the Nuclear Auxiliary Building (NAB). As a result, failure of a check valve in any of these discharge lines does not provide an opportunity for backflow from one sump discharge into another.

The collection tank in the NAB has separate nozzles for each incoming line, and an air gap provides further protection against backflow to the sumps.

U.S. EPR FSAR, Tier 2, Section 9.3.3.2.3 will be revised to state that sump pump discharge lines in each of the SB and FB are routed individually to their destination. U.S. EPR FSAR, Tier 2, Figure 9.3.3-1—Nuclear Island Drain and Vent System, Sheets 2 through 8 will be revised to show this piping layout.

FSAR Impact:

U.S. EPR FSAR, Tier 2, Section 9.3.3.2.3 and Figure 9.3.3-1, Sheets 2 through 8 will be revised as described in the response and indicated on the enclosed markup.

Question 09.03.03-6:

In reviewing the potential blockage of the NIDVS in accordance with SRP Section 9.3.3, Review Procedure (III.1.B), the staff found that FSAR Section 5.2.5.4 states that periodic testing of the floor draining system will verify that it is free of blockage. This periodic testing is acceptable for addressing the potential blockage concern. However, FSAR Section 5.2.5.4 is for the floor drain for reactor coolant pressure boundary (RCPB) leakage detection only. The staff can not find a similar periodic testing for the other floor drains. The applicant is requested to address in FSAR Section 9.3.3 the potential blockage and periodic testing of all the floor drains in the NIDVS.

Response to Question 09.03.03-6:

The nuclear island drain/vent system (NIDVS) will undergo preservice and startup inspection and testing. U.S. EPR FSAR, Tier 2, Section 5.2.5.4 states (referring to detecting RCPB leaks):

> “Periodic testing of the floor drainage system verifies that it is free of blockage.”

An inspection and testing program for the remainder of the floor drain system is not required because the flooding analysis does not take credit for the floor drainage system being free from blockage.

FSAR Impact:

The U.S. EPR FSAR will not be changed as a result of this question.

U.S. EPR Final Safety Analysis Report Markups

- NAB non-controlled area floor drains.

9.3.3.2.3 System Operation

09.03.03-4

During normal plant operation, the NIDVS collects different categories of liquid and gaseous effluents. Liquid leakages or discharges drain by gravity to sumps. Sump pumps automatically or manually transfer their contents to storage tanks. Sump discharge lines in each of the SB and FB are routed individually to their destination in the NAB.

Boron-containing reactor coolant leakage from primary vents, drains, pump seal and valve stem leakage, and safety valve discharges, is collected and stored for further processing to recover the boron by the coolant supply and storage system, coolant purification system and coolant treatment system. Liquid effluents produced by the decontamination facilities are collected and stored by the NIVDS for routing to the liquid waste storage system and then for processing in the liquid waste processing system. Recovered gaseous wastes are routed to the gaseous waste processing system or appropriate ventilation system for treatment.

9.3.3.3 Safety Evaluation

Safety-related components and equipment in the NIDVS include containment isolation valves (CIV), connecting piping and penetrations. CIVs are located in portions of the following subsystems:

- Drains/vents and safety valve discharges system - primary effluents inside RB.
- Type 1 floor drains system - RB floor drains.
- Type 2 floor drains system - low contamination RB drains.

The design of safety-related portions of the NIDVS satisfies GDC 2 regarding the effects of natural phenomena.

- Safety-related portions of the NIDVS are located in the RB and FB. These buildings are designed to withstand the effects of earthquakes, tornadoes, hurricanes, floods, tsunami and seiches. Section 3.3, Section 3.4, Section 3.5, Section 3.7 and Section 3.8 provide the bases for the adequacy of the structural design of the buildings.
- Safety-related portions of the NIDVS are designated Seismic Category I and are designed to remain functional during and following a safe shutdown earthquake (SSE). Section 3.7 provides the design loading conditions that are considered.
- Safety-related portions of the NIDVS are protected against the effects of flooding by consideration of the following design features: redundancy, location and physical separation.

- To cope with a large flooding event, the NIDVS sump located in the lowest level of the non-controlled areas of each SB is equipped with redundant safety-related level instrumentation to automatically trip the ESWS pump and close the associated discharge isolation valve. This instrumentation is located above floor level, provided with Class 1E power, and is classified as Seismic Category I.

09.03.03-2

- To notify the MCR operator of a flooding event and to begin operator action to isolate the flooding source, the RB sumps and the FB sumps are equipped with safety-related Seismic Category I instrumentation to alarm in the MCR.

The design of safety-related portions of the NIDVS satisfies GDC 4 regarding the capability to withstand the effects of and to be compatible with the environmental conditions (e.g., flooding) associated with normal operation, maintenance, testing and postulated accidents (e.g., pipe breaks, tank ruptures).

- Safety-related portions of the NIDVS inside the RB are located at sufficient elevation to be protected from flooding events inside this building.

09.03.03-2

- Sumps ~~pumps~~ inside the RB, SBs, and FB are equipped with safety-related Seismic Category I ~~a double~~ level ~~measurement~~instrumentation to mitigate the effects of internal flooding and maintain safe shutdown capability. This instrumentation provides alarms in the MCR to initiate operator action to isolate the flooding source or provides signals to automatically isolate the source. ~~The corresponding set point level in each sump is above floor level. In case of flooding inside these buildings, the dedicated level measurement systems are capable of detecting flooding at the lowest level.~~

- The NIDVS contains instrumentation that ~~detects water accumulation that can adversely affect the operation of safety-related equipment. This includes~~ monitors~~ing~~ the RCS leak tightness and reactor coolant inventory using leak detection and measurement means in the RB.

- The NIDVS is designed to prevent backflow of water through the drain systems into areas of the plant containing safety-related equipment by the use of check valves.

- Safety-related portions of the NIDVS are protected against the effects of internal missiles by consideration of the following design features: redundancy, location and physical separation.

- The NIDVS design considers: (1) actuation of installed fire suppression systems (e.g., gas and water), (2) accumulation of fire fighting water, and (3) prevention of backflow of combustible liquids into safety-related areas.

- Redundancy and physical separation of CIVs provide assurance that the containment isolation function is protected against fire-related events. The inner and outer CIVs are located in separate fire zones.

09.03.03-3

- The NIDVS, including floor drains and sump pumps, is assumed to be unavailable to mitigate the effects of internal flooding.

The design of the safety-related portions of the NIDVS satisfies GDC 60 concerning the suitable control of the release of radioactive materials in gaseous and liquid effluents, including AOOs.

- The NIDVS is designed to prevent the inadvertent transfer of contaminated fluids to non-contaminated drainage systems.
- Portions of the NIDVS that are located in areas that may contain radioactive effluents are physically separated from the plant areas that do not contain radioactive effluents. System design and operational controls monitor the transfer of effluents to the appropriate treatment systems.

9.3.3.4 Inspection and Testing Requirements

Safety-related portions of the NIDVS are inspected and tested as part of the initial test program. Refer to Section 14.2 (test abstract #098) for initial plant startup test program. The performance and structural integrity of system components is demonstrated by continuous operation.

CIV valve function and performance is tested in accordance with Technical Specifications in Chapter 16 of the FSAR and 10 CFR 50, Appendix J, programmatic requirements (refer to Section 6.2.6). Periodic inservice functional operation is monitored by instrumentation that readily identifies equipment degradation. Section 6.6 provides the ASME Boiler and Pressure Vessel Code, Section XI (Reference 1) requirements that are appropriate for the NIDVS.

9.3.3.5 Instrumentation Requirements

The CIS is originated by the reactor protection system. Containment isolation and containment valve position indication are available in the main control room. Control room alarms and indications are provided as required for:

- Water detection in the spreading area.
- RCS leakage.

09.03.03-2

- Flooding detection inside the RB (containment and annulus), SBs, and FB.~~Floor drain sump leak collection to detect flooding inside the RB.~~
- Automatic isolation of ESWS train in the event of a large flooding event in a SB.~~Floor drain sump leak collection to detect flooding inside the Annulus Building.~~

9.3.3.6 References

1. ASME Boiler and Pressure Vessel Code, Section XI: "Rules for Inservice Inspection of Nuclear Power Plant Components," The American Society of Mechanical Engineers, 2004.

Next File

of penetrations. Water is directed within one division to the building elevations below +0 feet, where it is stored. Above elevation +0 feet, a combination of watertight doors and openings for water flow to the lower building levels prevent water ingress into adjacent divisions. Watertight doors have position indicators for control of the closed position. Existing openings (e.g., stair cases, elevator shafts, and ~~building drains~~equipment openings) are credited as water flow paths~~ when available~~. Flooding pits with burst openings collect and direct water flow to lower building levels. Rooms within divisions have interconnections so that the maximum released water volume can be distributed and stored in the lower building levels of the affected division. Interconnections include doors with flaps, wall openings, and other wall penetrations that are not required to be sealed. Elevated thresholds, curbs, and pedestals are provided as necessary.

09.03.03-3

In Seismic Category I structures that are not designed with divisional separation, e.g., the Reactor Building (RB), the layout allows water released inside the building to flow to the lower level of the building. In the RB, water flows down to the in-containment refueling water storage tank (IRWST). In the annulus, water flows to the bottom level where it is stored. Safety-related systems and components in these structures are located above the maximum water level, protecting them from the effects of flooding. A COL applicant that references the U.S. EPR design certification will perform an internal flooding analysis prior to fuel load for the Reactor Building and Reactor Building Annulus to demonstrate that the essential equipment required for safe shutdown is located above the internal flood level or is designed to withstand flooding. Locations of essential SSC and features provided to withstand flooding will be verified by walk-down.

Leak detection and isolation measures mitigate the consequences of postulated pipe ruptures. Water level instrumentation and other leak detection measures detect pipe ruptures that could result in internal flooding. These leak detection systems provide a signal to automatically isolate the affected system or to provide indication to the main control room (MCR) to initiate operator action from within the MCR or locally. Section 3.6 provides further information on protection mechanisms associated with the postulated rupture of piping.

The nuclear island drain and vent system (NIDVS) prevents backflow of water from affected areas of the plant that contain safety-related equipment. The NIDVS is conservatively considered not available for reducing water volume by the respective sump pumps, and floor drains are assumed to be plugged.

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3.4.2 External Flood Protection

The Seismic Category I SSC listed in Section 3.2 can withstand the effects of external flooding due to natural phenomena and postulated component failures. Seismic analysis demonstrates that internal flooding resulting from a postulated initiating event does not cause the loss of equipment required to achieve and maintain safe shutdown of the plant, emergency core cooling capability, or equipment whose failure could result in unacceptable offsite radiological consequences. Section 7.4 describes the safety-related systems and components required for safe shutdown of the plant. The internal flooding analysis also describes the flooding protection measures that mitigate the consequences of flooding in areas that contain safety-related systems and components.

Sources of flooding considered in the internal flooding analysis include high- and moderate-energy line ruptures, improper system valve alignments, tanks, fire protection systems, and water from adjacent buildings.

The internal flooding analysis is conducted on a level-by-level and room-by-room basis for the Seismic Category I structures for the postulated flooding events. The analysis consists of the following:

- Identification of safety-related equipment.
- Identification of potential flooding sources.
- Determination and comparison of flood water volumes and building volumes.
- Evaluation of effects on required equipment.
- Determination of the need for protection and mitigation measures.

The following criteria and assumptions are used to determine flood water volumes and flow rates:

- For closed systems and storage tanks, the complete system or tank content is assumed to be released.
- If isolation of the pipe leak or break is assumed, only the released water volume within the operator action time is considered.
- The maximum operational pressure is used to estimate leakage flow rates.
- Released steam is considered to be completely condensed.
- Criteria and assumptions described in Section 3.6 are used to determine break configurations, locations, and flow rates for postulated high- and moderate-energy pipe ruptures.

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- Floor drains are assumed to be plugged and sump pumps are assumed to be not available for reducing flood water volume.

Equipment and components of these systems that are sensitive to flooding are generally located above elevation -4 feet, 3 inches. This arrangement provides a margin between the normal operation maximum water level of the IRWST and these components, in order to store water released from postulated pipe failures and avoid a consequential failure by flooding.

In the event of piping failures, water flows directly to the IRWST while steam condenses on structures (e.g., concrete walls, containment walls, ceilings, and floors) and flows to the IRWST.

The analysis is focused on postulated piping failures that lead to the largest volume of released water inside containment. The following cases are enveloping scenarios for released water volume in containment:

- Water from a large break loss-of-coolant-accident (LOCA) in the reactor coolant pressure boundary (i.e., release of reactor coolant system inventory, pressurizer water volume, and the inventory of accumulators).
- Postulated pipe break in a main steam line.
- Postulated pipe break in a main feedwater line.
- Postulated pipe break in the fire water distribution system ring header.

The postulated pipe break in the fire water distribution system ring header is considered the bounding case for the maximum released water volume in containment. This water volume results from an assumed complete separation of piping ends, a flow rate limited by the maximum possible pump capacity, and an MCR operator action time of thirty minutes before closing the containment isolation valves and the fire water distribution system isolation valves at the entrance to Safeguard Buildings (SB) 1 and 4. The resulting water level is estimated to be at elevation -4 feet, 7 inches. There are no safety-related SSC required to perform a safety-related function while being completely or partially submerged.

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Inside containment, leakages are integrally detected by measuring humidity, temperature, condensate flow, and water levels in drain and vent collection tanks or sumps. Depending on the leak and break size and the affected system, the protection system initiates automatic measures as required to cope with the event (e.g., LOCA, main steam line break, or main feedwater line break). A NIDVS sump located at level -7 feet, 6-1/2 inches is equipped with safety-related Seismic Category I level instrumentation to initiate alarms in the MCR for a filled sump and large flooding event. These alarms notify the MCR operator to begin action to isolate the FWDS.

To avoid water ingress into the corium spreading area, which could produce a steam explosion in case of an accident, the venting area from the spreading compartment has a watertight door.

The released water from fire fighting by hose streams or a deluge system is enveloped by the higher flow rates and released water volumes from the relevant postulated pipe failures.

Reactor Building Annulus

Below elevation +0 feet, the annulus between the Shield Building and the Containment Building is a single volume; therefore, it is considered one room for flooding protection purposes. Water released from a specific location flows down in the annulus and collects on the bottom level. Because high-energy piping (e.g., main steam lines and main feedwater lines) is routed inside guard pipes, there is no water accumulation in the annulus due to their failure. Therefore, the analysis is focused on water-carrying systems without guard pipes. The case that results in the largest water volume released in the annulus is a postulated pipe break in the fire water distribution system. The volume of released water is based on an assumed full break in the piping, a flow rate limited by the maximum pump capacity, and an operator action time of thirty minutes to isolate the system after receiving the first alarm in the MCR. The fire water distribution system is isolated by manually closing the isolation valves at the entrances to SB-1 and SB-4. Two motor-operated isolation valves, powered from different electrical divisions, are provided in series for isolation. The resulting flood level in the annulus is below elevation +0 feet.

Inside the annulus, only the plug boxes of cable penetrations for electrical and instrumentation and control equipment located above elevation +16 feet, 10-3/4 inches could be affected by flooding. In the event of a postulated break in the fire water distribution system, the annulus ventilation system supply is lost because the annulus ventilation duct is flooded through the grids. Furthermore, the normal operating mode of the SB controlled area ventilation system could be lost because of water entering through the inspection openings. These consequences are acceptable because the safety-related functions are fulfilled by the annulus ventilation system exhaust trains which maintain sub-pressure in the annulus, the accident mode of the SB controlled area ventilation system which maintains sub-pressure in the SBs, and the recirculation mode of the SB controlled area ventilation system which maintains ambient conditions in the SBs.

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Leak detection inside the annulus consists of ~~two~~ safety-related Seismic Category I level measurements in the NIDVS sump located on elevation -14 feet, 1-1/4 inches. These level measurements initiate an alarm in the MCR for a filled sump (considered as the first alarm for initiating the operator action time for isolation) and an alarm for a flooding event above floor level -14 feet, 1-1/4 inches.

The hydrostatic water loads corresponding to an elevation of +0 feet are taken into account in the structural design of the annulus walls and for the watertight design of cable and piping penetrations below this elevation. The water released during fire was initiated. Sufficient openings and thresholds direct water flow to the lower building levels.

Potential sources of flooding located on these building levels include the demineralized water distribution system, safety chilled water system (SCWS), fire water distribution system, CCWS including surge tank, and the potable and sanitary water disposal system. These systems have been reviewed for possible effects on the MCR and remote shutdown station (RSS) because they are located above the MCR, and measures are provided to protect the MCR and RSS from flooding. No water-carrying piping systems are located in the MCR or RSS. Thresholds are provided for doors entering the MCR and water resistant doors are provided for entry doors to the RSS. For the fire water distribution system, demineralized water distribution system, and the CCWS, multiple openings and flow paths direct flood water from pipe breaks to lower building levels. Surge tank water tightness is provided by a steel liner and leak detection system.

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Each division of the SCWS contains a limited volume of water that can either be stored in the area where it was released or drained to the building sump or to the lowest building level. At higher building elevations (e.g., elevation +69 feet), the pumps are automatically stopped on loss of system pressure, limiting the volume of water released at these elevations. A common loss of the heating, ventilation, and air conditioning (HVAC) system trains for the MCR due to flooding from a pipe break in the SCWS is avoided by flow paths, ~~drains,~~ and by placing equipment that is sensitive to flooding above the expected flood water height. Consequences of a pipe failure of a SCWS drain in Division 1 on safety-related equipment in SB-2 are avoided because the drain of Division 1 is located in areas where there are no safety-related components of Division 2 that are sensitive to flooding. Therefore, the consequences of a flooding event from the SCWS are restricted to one redundant division.

Leak detection is provided by level measurement in the NIDVS building sump. Specific leak detection measurements near the MCR detect pipe failures in the potable and sanitary water distribution system. Two remotely operated valves in the potable and sanitary water disposal system in SB-1 close automatically when the filled level is reached in the NIDVS building sumps. Generally, the water released from a break in the potable and sanitary water distribution system drains toward the NIDVS building sumps. However, for the restrooms this is not appropriate because of the possibility of sewage water ingress into the NIDVS. Therefore, there are additional local detection measures in rooms adjacent to the MCR, consisting of two level measurements that provide a close signal to the isolation valves in SB-1 and an alarm to the MCR. The released water can be stored in the affected area until system isolation without flooding to safety-related areas.

Fire fighting in the vicinity of the MCR, RSS, and the HVAC floor above the MCR complex is considered. Within a SB, the water released because of fire fighting is water tightness. There are no ventilation penetrations in these walls. The NIDVS is interconnected between the different FB divisions and with the SBs and the Nuclear Auxiliary Building (NAB). Ingress of water by backflow in the system from one area to the others is prevented by redundant check valves in series. Piping penetrations from FB-2 toward the NAB are watertight for an elevation corresponding to building level of +0 feet in the NAB.

The building is designed for the water mass corresponding to one completely filled building area up to elevation +0 feet. The building layout is designed to direct released water within one FB division to the building levels below elevation +0 feet where physical separation exists. FB-1 and FB-2 are connected to SB-1 and SB-4, respectively, via passageways. To avoid water ingress into the adjacent division and in and out of adjacent buildings at elevation +0 feet and above, a combination of watertight doors and openings for water flow to the lower building levels are provided. The doors from the FB to SB-1 and SB-4 at elevations -31 feet, -20 feet, and -11 feet are physical protection doors. These doors are not watertight because the adjacent SB belongs to the same division. Failures in piping systems below elevation +0 feet would lead to consequential failures in only one division, SB-1 and FB-1 or SB-4 and FB-2. Below elevation +0 feet, the rooms within one division have interconnections so that the maximum released water volume can be stored within the division. Interconnections include doors with flaps, burst openings, and other wall penetrations that are not required to be sealed.

Excessive water losses from the fuel pool are avoided by locating piping connections near the top of the fuel pool and by the use of siphon breakers. Any released water is directed within the affected division to the lower building levels where it is distributed between the affected FB and the connected SB (i.e., FB-1 and SB or FB-2 and SB-4). If one fuel pool cooling train is lost because of flooding from a leak in its piping, the train located in the other division is still available.

The bounding flooding source is a postulated break in the main piping of the fire water distribution system. The main fire water distribution system ring header is located in the interconnecting passageway between the FB and SBs. In order to avoid water ingress into the adjacent division, a combination of watertight doors and openings for water flow to the lower building levels are provided. Existing openings are considered as water flow paths when available. The volume of released water is based on an assumed full break in the piping, a flow rate limited by the maximum pump capacity, and an operator action time of thirty minutes to isolate the system after receiving the first alarm in the MCR. Based on the available free volume of the building levels in each division, the water can be stored within the affected division. The FB NIDVS floor drain sump level measurement instrumentation is safety-related Seismic Category I and includes an alarm signaling a flooding event.

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Figure 9.3.3-1—Nuclear Island Drain and Vent System
Sheet 2 of 8

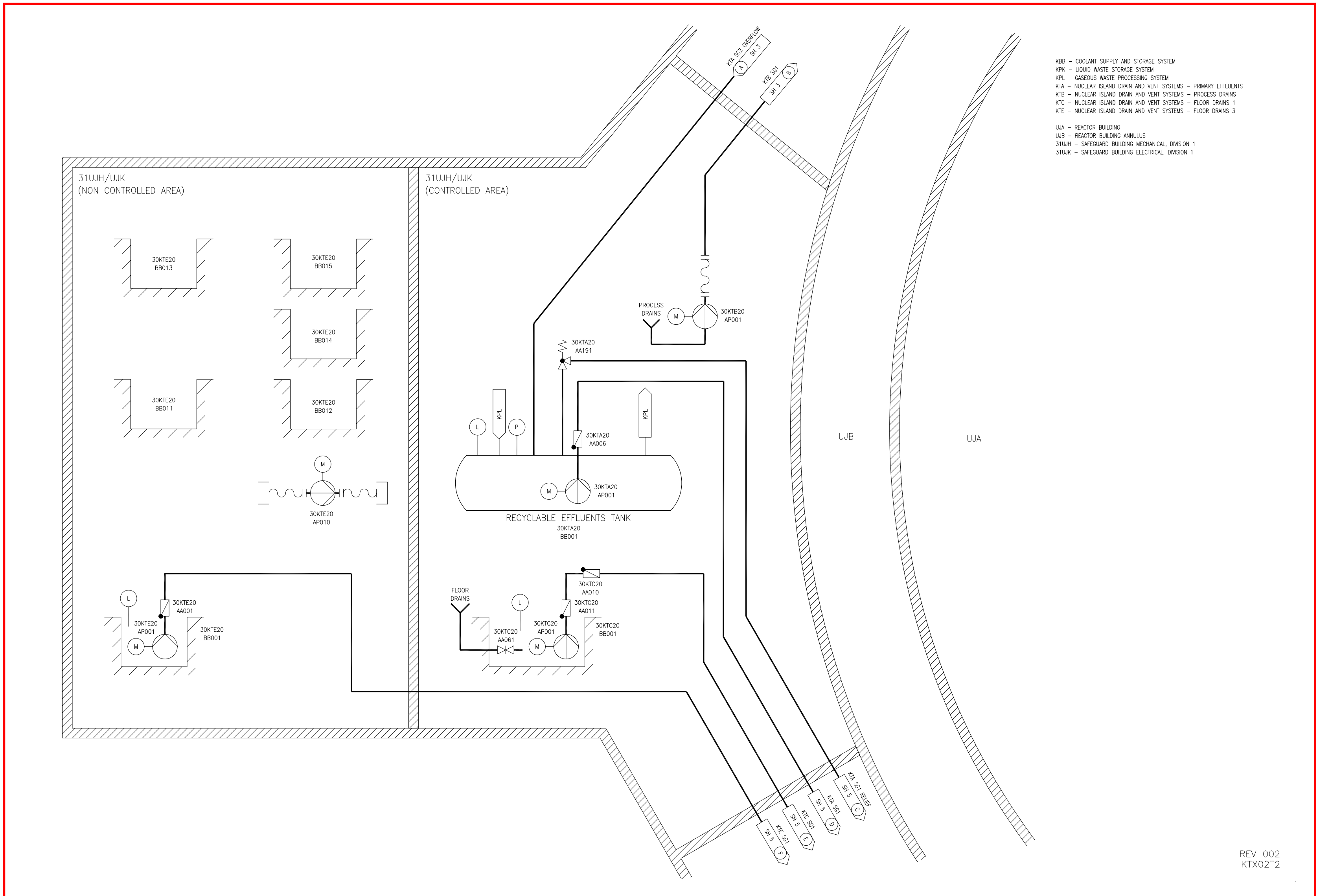

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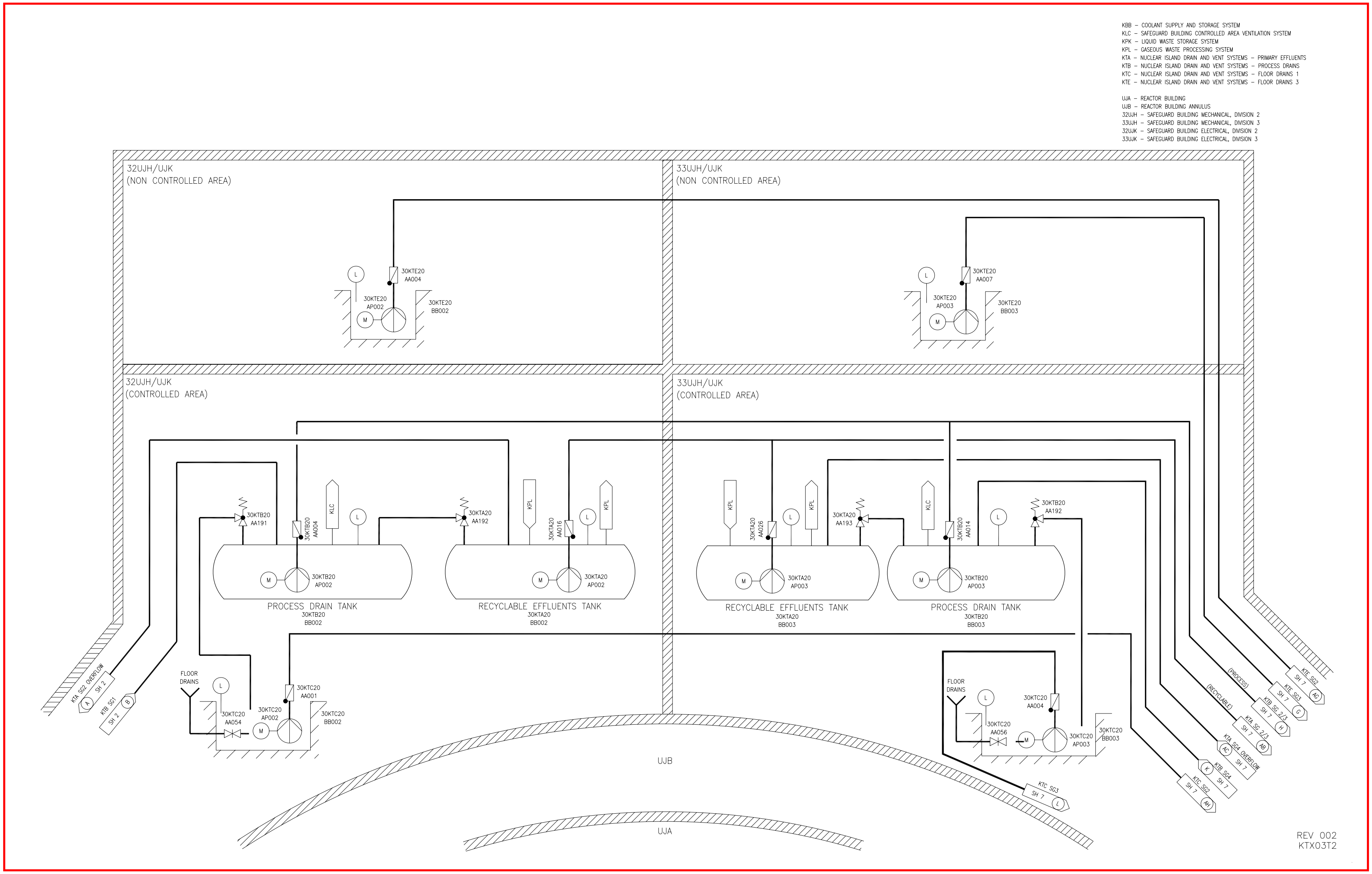
Figure 9.3.3-1—Nuclear Island Drain and Vent System
Sheet 3 of 8



09.03.03-4

Figure 9.3.3-1—Nuclear Island Drain and Vent System
Sheet 4 of 8

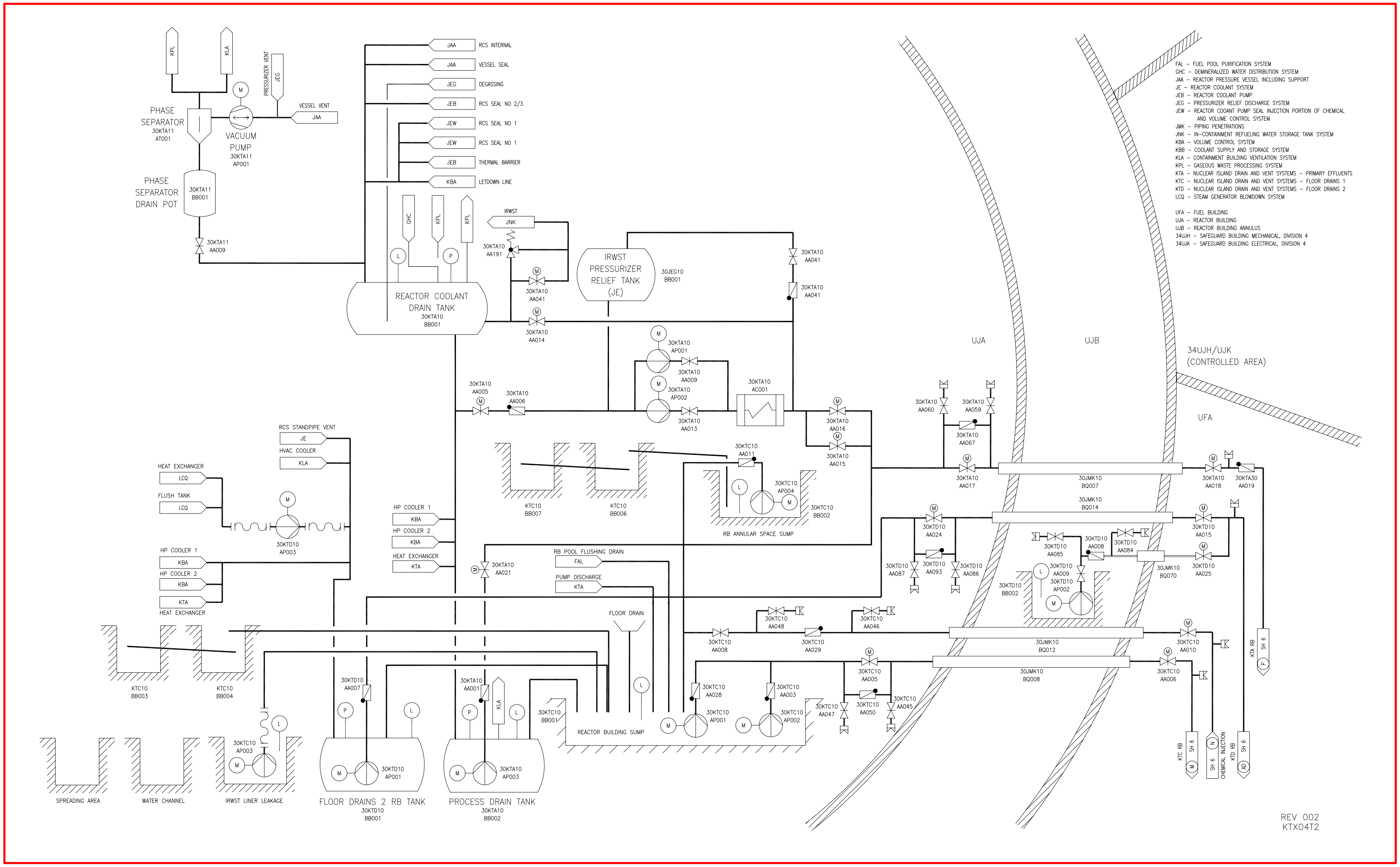


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Figure 9.3.3-1—Nuclear Island Drain and Vent System
Sheet 5 of 8

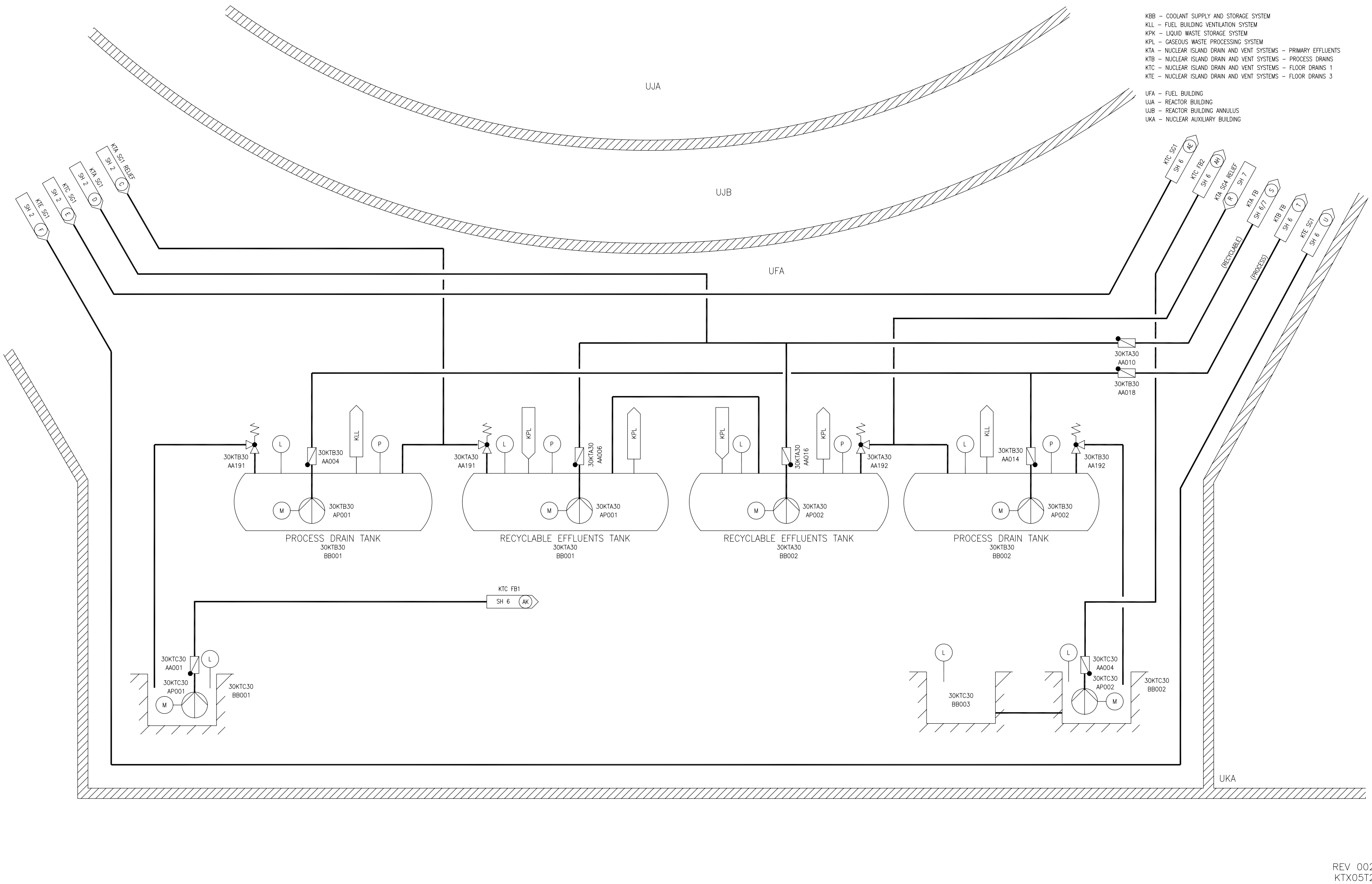

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**Figure 9.3.3-1—Nuclear Island Drain and Vent System
Sheet 6 of 8**

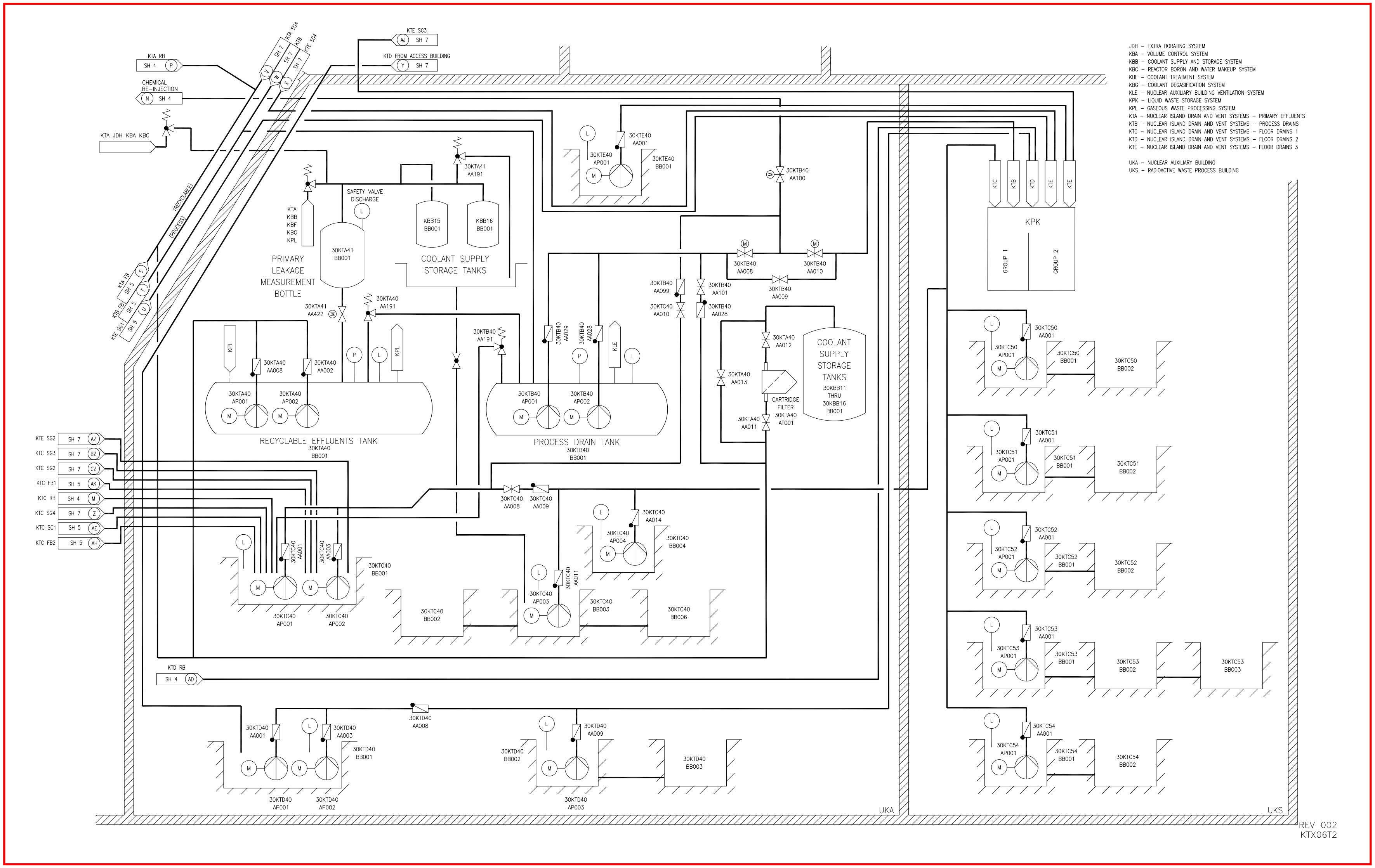

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Figure 9.3.3-1—Nuclear Island Drain and Vent System
Sheet 7 of 8

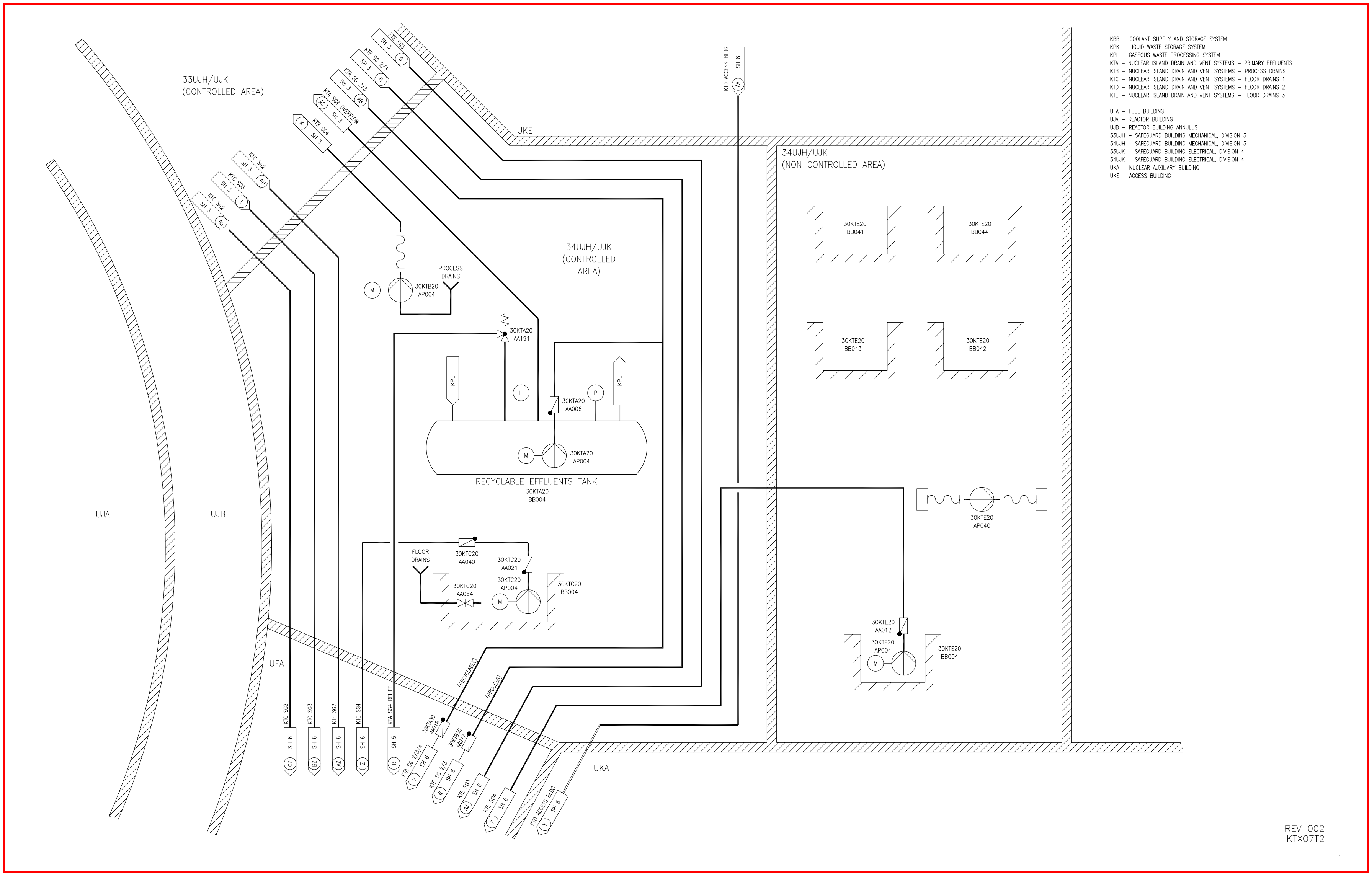

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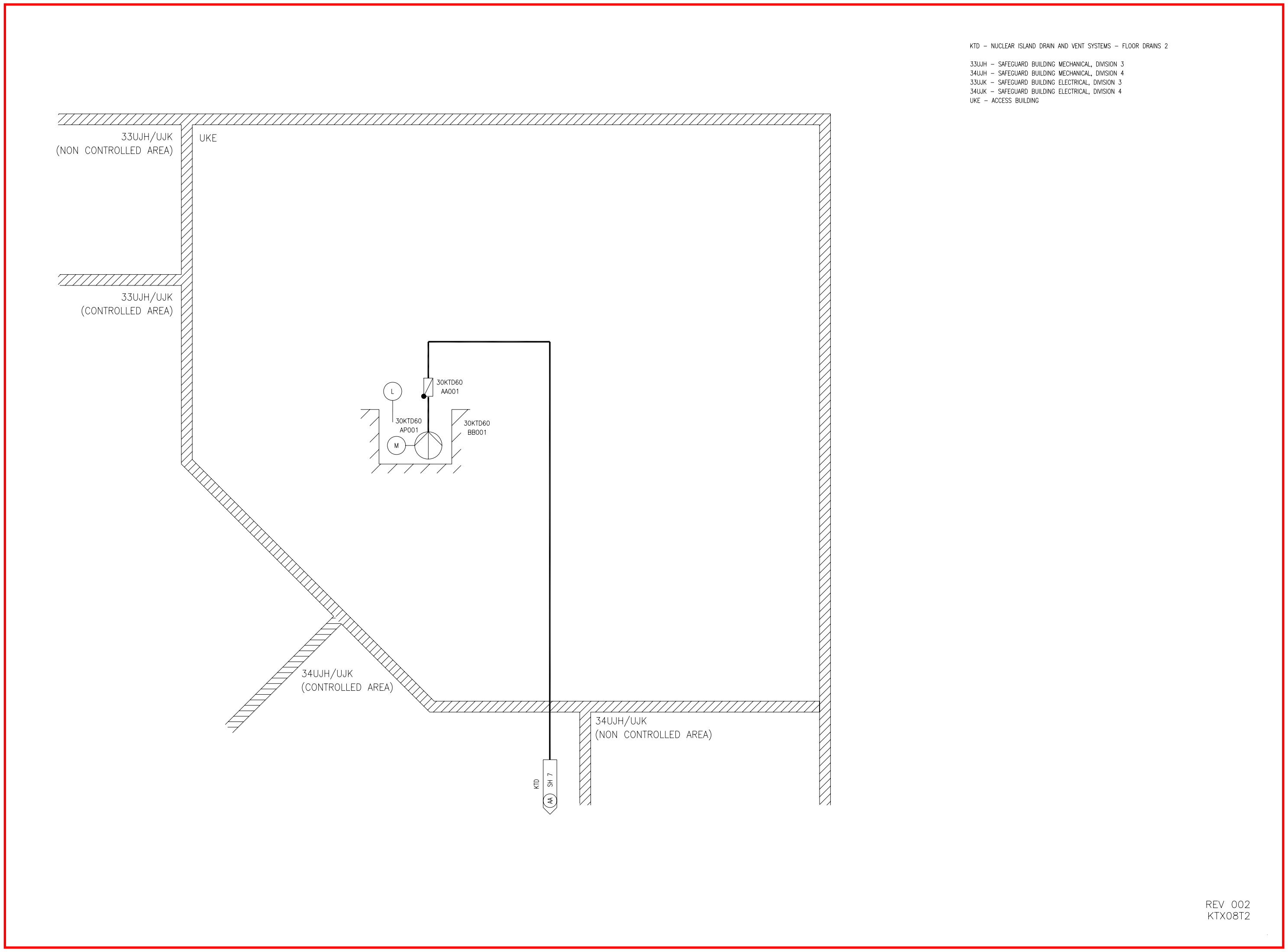
Figure 9.3.3-1—Nuclear Island Drain and Vent System
Sheet 8 of 8



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