CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

TRIP REPORT

SUBJECT: Visit to BNFL Inc. Integrated Safety Management Cycle 2 Topical Meeting (20.01403.201)

DATE/PLACE: May 31–June 1, 2000, Richland, Washington

AUTHOR: Lietai Yang/Center for Nuclear Waste Regulatory Analyses (CNWRA)

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PERSONS PRESENT: BNFL Inc. Technical Staff
U.S. Department of Energy (DOE) Regulatory Unit (RU) Technical Staff
G. Comfort/Nuclear Regulatory Commission (NRC)
R. Shewmaker/NRC
L. Yang/CNWRA

BACKGROUND AND PURPOSE OF TRIP:

Topical meetings are periodically conducted by BNFL Inc. on the Tank Waste Remediation System-Privatization (TWRS-P) projects to discuss and resolve major technical and programmatic issues. Selected meetings are attended by CNWRA technical staff to monitor the progress and become aware of new developments in the design. At the Topical Meeting on May 31 and June 1, 2000, BNFL Inc. discussed the results of the Integrated Safety Management (ISM) Cycle 2 work.

SUMMARY OF PERTINENT POINTS:

In the Topical Meeting on May 31 and June 1, 2000, BNFL Inc. presented the results of the ISM work performed by BNFL Inc. through March 29, 2000. The topics discussed in this meeting included Hazard Identification and Evaluation, Design Basis Events (DBEs), and Standards Identification for the TWRS-P facilities.

On May 31, 2000, the meeting focused on the presentation by the technical team of BNFL Inc. on the following four topics:

- Overview of Design Basis for ISM
- Hazards/Preliminary DBEs for the Pretreatment (PT) Facilities
- Hazards/Preliminary DBEs for the High-Level Waste (HLW) Vitrification Facility
- Hazards/Preliminary DBEs for the Low-Activity Waste (LAW) Vitrification Facility

These presentations summarized the materials described in the BNFL Inc. May Topical Report, Summary of ISM I and II—Preliminary. However, in the presentation, the Severity Level 1 (SL-1) hazards were divided into two categories: SL-1* (>5000 rem) and SL-1 (≤5000 rem). Appendix A shows the ISM Cycle II results provided at the meeting. In addition, the presentation also summarized the hazard results for different types of accidents (appendix B), which were not provided in the report.

On June, 1, 2000, the meeting focused on the demonstration of DBE Selections and Standards Identification for example DBEs. The following procedures were used in the selection of DBEs:

(i) Grouped by Facility

- All the identified events are grouped by facilities (PT, HLW and LAW)

(ii) Event Screening

- Events that are identified as operational concerns without consequences are screened out
- Events that have no significant consequences (less than SL-3) are screened out

(iii) Grouped by Safety Case Requirement (SCR)

- The events are grouped by SCR to ensure that the bounding event(s) against a given SCR is representative of the events that place demands on that SCR

The logic as shown in appendix C was followed to determine the DBE or DBEs for each type of event (drops, fire, liquid spills, etc.). There may be more than one DBE within each type of event in the same SCR group.

BNFL Inc. discussed the selection of DBEs in the HLW facility under SCR–HVENT/N0001 (C5 exhaust will be filtered to acceptable limits prior to discharge to the environment) as an example. There are 90 events or Hazard Situations (HS) (which fall into 10 types of events such as drops, molten glass spill, liquid spills, and loss of contamination control) with greater than SL-4 consequences linked to this particular SCR. Within the molten glass spill type of event, there are five greater than SL-4 events and one DBE. That DBE is "breach of confinement and subsequent loss of glass from the melt pool caused by failure of the refractory package due to erosion/corrosion, operational error (thermal cycling, excessive temperature), shifting of refractory bricks, and failure of electrode/seal due to arching or shorting" (HS ID: CSD–H210/N0036). Under SCR–HVENT/N0001, there is a total of 12 DBEs among the 90 HSs.

Other examples discussed include:

- DBE in the LAW facility linked to SCR–LPIPN/N0017 (The LAW vessels and associated equipment are designed to the appropriate level of integrity requirements to prevent failure during the expected lifetime of the facility considering all associated process conditions.)

  Event CSD–L100/0067 in the LAW facility was selected as the DBE for all 16 events (or HSs) under SCR–LPIPN/N0017. Event CSD–L100/0067 is "failure of equipment and release of radioactive materials-worker exposure to airborne contamination caused by erosion of melter feed

preparation/feed vessels and piping due to abrasive additives or corrosion included by process chemistry."

- DBEs in the HLW facility that are related to molten glass spill accident.

  The molten glass spill accident involves three SCRs and 16 DBEs:

  — SCR–HPIPN/N0001 (Piping and vessels shall be designed appropriately, including parameters such as material selections, thickness, corrosion/erosion allowance, appropriate seismic qualification, etc., to ensure confinement for minimum plant design life.)

    There is 1 DBE under this SCR.

  — SCR–HVENT/N0001 (C5 exhaust will be filtered to acceptable limits prior to discharge to the environment.)

    There are 12 DBEs under this SCR. One of the DBEs is also the DBE under SCR–HPIPN/N0001.

  — SCR–HVENT/N0003 (Maintain cascade air flow from areas of lower contamination to areas of higher contamination.)

    Eleven events were identified as the DBEs under this SCR. Seven of the 11 DBEs are also the DBEs under SCR–HVENT/N0001 and one of these 7 is also the DBE under SCR–HPIPN/N0001.

  The DBEs common to all the three SCRs are CS–210/N0036 [Breach of confinement and subsequent loss of glass from the melter pool caused by failure of the refractory package due to erosion/corrosion, operational error (thermal cycling, excessive temperature), shifting of refractory bricks, and failure of electrode/seal due to arching or shorting.]

- DBEs in the PT facility that are related to SCR–PPVV/N0002 (Ensure sufficient air flow to maintain hydrogen concentration below flammable limit.)

  Six events were identified as the DBEs for 28 Hazard Situations linked to this SCR.

Control Strategies and Standards Identification were discussed for some SCRs such as SCR–LPIPN/N0017 mentioned above. American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section VIII, Division 1, will be used as the standard to ensure that vessels will be designed, fabricated, tested and inspected in accordance with an approved quality control system in compliance with safety standards.

The DOE RU expressed concerns that the presentation by BNFL Inc. did not adequately show that BNFL Inc. had followed the Design Guide in the process of identifying the DBEs and selecting the standards. Specifically, the presentation was not clear to the DOE RU on how each control strategy or selected standard addressed the safety requirement according to the Design Guide. BNFL Inc. admitted there was a problem with the presentation; but they indicated they followed the Design Guide in deriving the DBEs and the standards.

IMPRESSIONS/CONCLUSIONS:

The meeting was quite useful in understanding the approaches used by BNFL Inc. in the selection of DBEs and in the identification of standards.

PROBLEMS ENCOUNTERED:

None.

PENDING ACTIONS:

None.

RECOMMENDATIONS:

Continued attendance at similar meetings will help CNWRA to better understand and review the BNFL Inc. designs.

SIGNATURE:

L. Yang
Research Engineer

06/16/00
Date

N. Sridhar
Manager
Corrosion Science and Process Engineering Element

6/17/00
Date

CONCURRENCE:

Budhi Sagar
Technical Director

6/20/2000
Date

APPENDIX A
PRELIMINARY INTEGRATED SAFETY MANAGEMENT CYCLE II RESULTS ACCORDING TO CONSEQUENCES

Table A-1. Preliminary Integrated Safety Management Cycle II results for high-level waste vitrification[1]

Consequence	Number of Events		
	To Facility Worker	To Co-Located Worker	To Public
SL-1*	22	0	0
SL-1	169	62	0
SL-2	22	52	0
SL-3	48	13	59
SL-4	130	178	246
N/A[2]	56	142	142
AT[3]	0	0	0
BT[4]	36	36	36
Total	483	483	483

[2] — Not applicable
[3] — Above threshold (for quantities of chemicals released)
[4] — Below threshold (for quantities of chemicals released)

Table A-2. Preliminary Integrated Safety Management results for low-activity waste vitrification[1]

Consequence	Number of Events		
	To Facility Worker	To Co-Located Worker	To Public
SL-1*	0	0	0
SL-1	0	0	0
SL-2	19	0	0
SL-3	7	3	0
SL-4	173	175	178
N/A[2]	0	21	21
AT[3]	45	0	0
BT[4]	20	65	65
Total	264	264	264

[2] — Not applicable
[3] — Above threshold (for quantities of chemicals released)
[4] — Below threshold (for quantities of chemicals released)

[1] BNFL Inc. Technical Staff. *Presentation: May 31, 2000.* Richland, WA: BNFL Inc., River Protection Project Waste Treatment Plant.

Table A-3. Preliminary Integrated Safety Management Cycle II results for pretreatment[1]

Consequence	Number of Events		
	To Facility Worker	To Co-Located Worker	To Public
SL-1*	87	43	0
SL-1	223	145	39
SL-2	86	14	23
SL-3	57	36	38
SL-4	191	165	299
N/A[2]	21	282	285
AT[3]	0	0	0
BT[4]	35	22	22
To be determined	36	29	30
Total	736	736	736

[2] — Not applicable
[3] — Above threshold (for quantities of chemicals released)
[4] — Below threshold (for quantities of chemicals released)

[1] BNFL Inc. Technical Staff. *Presentation: May 31, 2000.* Richland, WA: BNFL Inc., River Protection Project Waste Treatment Plant.

APPENDIX B
PRELIMINARY INTEGRATED SAFETY MANAGEMENT CYCLE II RESULTS ACCORDING TO ACCIDENT TYPES

Table B-1. Preliminary Integrated Safety management Cycle II results for high-level waste vitrification[1]

Accident Type	Number of Identified Hazardous Situations
Boiling	2
Chemical Hazard	36
Chemical Reaction	5
Direct Radiation	96
Drop of Radioactive Material	34
Drop onto Radioactive Material	1
Explosion	14
Fire	22
Liquid Spill/Overflow	79
Loss of Contaminated Control	134
Molten Glass Spill	8
Offgas Release	28
Pressurized Release	15
Spray Leaks	6
Steam Release	3
Total	483

[1] BNFL Inc. Technical Staff. *Presentation: May 31, 2000.* Richland, WA: BNFL Inc., River Protection Project Waste Treatment Plant.

Table B-2. Preliminary Integrated Safety Management results for low-activity waste vitrification[1]

Accident Type	Number of Identified Hazardous Situations
Chemical Hazard	21
Chemical Reaction	4
Direct Radiation	25
Drop of Radioactive Material	17
Explosion	7
Fire	7
Liquid Spill/Overflow	32
Loss of Contaminated Control	83
Molten Glass Spill	18
Offgas Release	41
Spray Leaks	8
To be determined (loss of chilled water to HVAC)	18
Total	264

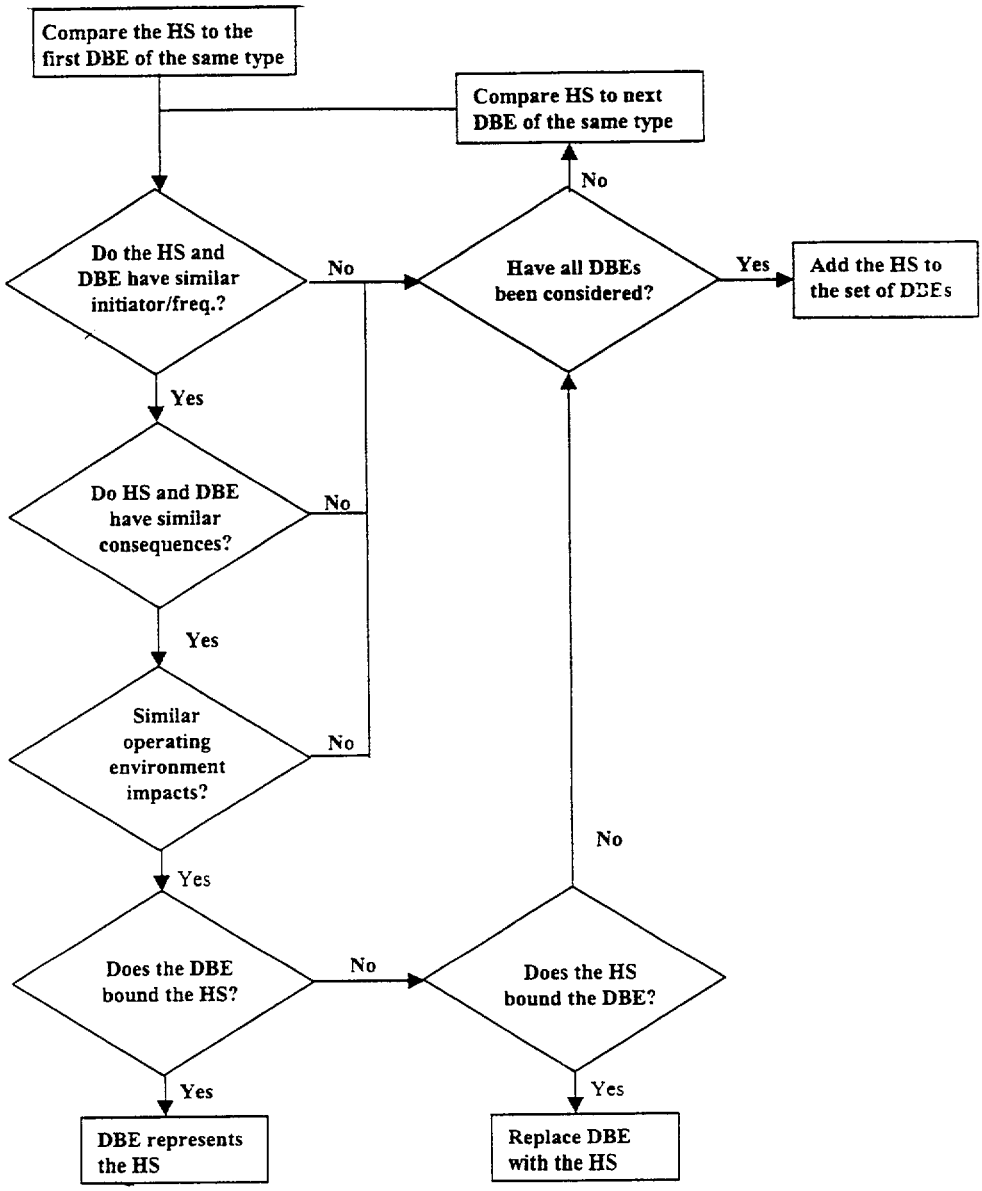
[1] BNFL Inc. Technical Staff. *Presentation: May 31, 2000.* Richland, WA: BNFL Inc., River Protection Project Waste Treatment Plant.

Table B-3. Preliminary Integrated Safety management Cycle II results for pretreatment[1]

Accident Type	Number of Identified Hazardous Situations
Boiling	12
Chemical Hazard	29
Chemical Reaction	32
Direct Radiation	165
Drop of Radioactive Material	32
Drop onto Radioactive Material	1
Explosion	44
Fire	26
Liquid Spill/Overflow	135
Loss of Contaminated Control	164
Offgas Release	47
Pressurized Release	20
Spray Leaks	15
Steam Release	11
Unassigned	2
Total	736

[1] BNFL Inc. Technical Staff. *Presentation: May 31, 2000*. Richland, WA: BNFL Inc., River Protection Project Waste Treatment Plant.

APPENDIX C
DESIGN BASIS EVENT SELECTION LOGIC[1]



[1] BNFL Inc. Technical Staff. *Presentation: May 31, 2000.* Richland, WA: BNFL Inc., River Protection Project Waste Treatment Plant.