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POTENTIAL SAFETY-RELATED INCIDENTS WITH POSSIBLE APPLICABILITY TO A NUCLEAR FUEL REPROCESSING PLANT

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S R L I N C I D E N T S D A T A B A N K

POTENTIAL SAFETY-RELATED INCIDENTS WITH POSSIBLE APPLICABILITY TO A NUCLEAR FUEL REPROCESSING PLANT

INTRODUCTION

The Safety Technology Group is developing methodology that can be used to assess the risk of operating a plant to reprocess spent nuclear fuel. This methodology is a modified probabilistic analysis and has been applied successfully to analyses of existing Savannah River Plant (SRP) facilities.

As an early step in the methodology, a preliminary hazards analysis identifies safety-related incidents. In the absence of appropriate safety features, these incidents could lead to significant consequences and risk to onsite personnel or to the public. This report is a compilation of potential safety-related incidents that have been identified in studies at SRL and in safety analyses of various commercially designed reprocessing plants. It is an expanded revision of the version originally published as DP-1558, published December 1980.

SUMMARY

A total of about 1000 safety-related incidents pertaining to 114 process operations or categories have been identified in eight major sections, as shown in Table 1. By themselves or in concert with other incidents, they may have significant and adverse consequences for the safety of operating personnel and/or the offsite population if appropriate safety features are not provided. Possible causes and potential consequences are identified. Safety features are cited which, if incorporated in either the design or operating procedures of a fuel processing facility may serve to prevent the incident, warn of its occurrence, or mitigate its consequences.

This report includes the Table of Contents only, rather than the entire databank. Access to the databank or a computer printout of the incidents may be obtained from the authors.

TABLE 1
SRL INCIDENTS DATABANK

Section	Title	Operations/ Categories	Number of Incidents
1.0	GENERAL INCIDENTS ASSOCIATED WITH FUEL PROCESSING AND WASTE SOLIDIFICATION	11	100
2.0	SPECIFIC INCIDENTS FOR FOR FUEL PROCESSING	10	141
3.0	SPECIFIC INCIDENTS FOR DEFENSE WASTE SOLIDIFICATION	24	300
4.0	INCIDENTS FOR HB-LINE OPERATIONS (SRP)	21	162
5.0	SPECIFIC INCIDENTS FOR THE INTEGRATED HOT OFF-GAS FACILITY	17	120
6.0	INCIDENTS FOR URANIUM FINISHING	11	48
7.0	SPECIFIC INCIDENTS FOR WASTE HANDLING (LWR)	5	71
8.0	INCIDENTS FOR PLUTONIUM FINISHING	15	62

DISCUSSION

Incidents in reprocessing plants differ in several respects from reactor incidents. In nuclear reactors, the dominant incidents can be described by only two conditions, loss of coolant and power increase. In reprocessing plants, however, a very large number of incidents are possible each of which can result in the loss of small amounts of radioactivity from the facility if engineered safety features are not provided.

Specific differences between the reprocessing and reactor systems are listed below.

- A much larger fraction of incidents in reprocessing plants can be expected to result directly from human error because less automation is used.

- The frequency of incidents resulting in small loss of radioactivity from primary containment in a reprocessing plant can be expected to be greater because of the mobility of the materials and the continual movement of materials between operations.

- The potential energy in reprocessing systems is much lower, and significant penetration of protective barriers is more difficult; the frequency of significant penetration per initiating event is therefore lower.

- The consequences of reprocessing incidents are lower because the integrity of the barriers can be maintained even under severe conditions.

- The inventory of short-lived isotopes in reprocessing systems is significantly less than in reactor systems.

Identification of potential incident initiators in reprocessing must be based on experience in non-nuclear chemical plants, and on judgement. Such an identification has been made, and the data have been stored in computer library T2274.TECH.DATA for convenient retrieval.

Description

The incidents in the databank are grouped into General Incidents and Specific Incidents as shown in Table 1. The General Incidents are generic events that can occur in many of the unit operations and processes; these are grouped according to type, e.g., fires. Since a reprocessing plant operates essentially as a series of diverse and nearly independent operations, Specific Incidents are grouped according to operation, e.g., product evaporation. Some General Incidents are repeated in a few instances, in the Specific Incidents section, as appropriate to certain operation. Specific Incidents are cited separately for spent fuel processing, waste solidification, uranium finishing, plutonium finishing, and off-gas treatment.

The detailed format for each of the incidents includes causes, consequences, and safety features for prevention, detection, and mitigation. Causes are not listed for incidents, such as natural phenomena, that occur externally. Consequences are identified qualitatively, but not quantitatively. An example of the databank format is given in Table 2. The remainder of the databank is available on request.

Procedure

The compilation of potential incidents which follows has been used at SRL in identifying safety features for inclusion in the design of new facilities and should prove useful elsewhere for both design work and for safety analyses. The terminology in solvent extraction incidents is consistent with SRL terminology for coprocessing. This databank may be applicable to the reprocessing of both power and production reactor fuels.

(Coprocessing includes processing to recover both uranium and plutonium.)

The procedure for using this databank is:

- Select a system or subsystem for analysis.
- Identify the process operations and equipment.
- Obtain the General and Specific Incidents for each operation and equipment piece. Databank member names are given in the Table of Contents.
- Delete incidents that do not apply, e.g. for reasons of differences in fuel type, equipment used, or process method.

The resulting list of potentially applicable incidents can be used as part of a preliminary hazards analysis. The list is also useful for further consideration in another tool for safety analysis, the "What If" meeting, described in DP-1584, published in 1981.

TABLE 2

DATABANK FORMAT

1.0 GENERAL INCIDENTS (I0100)

1.01. NATURAL PHENOMENA (I0101)

1.01.01. EARTHQUAKE GREATER THAN SAFE SHUTDOWN EARTHQUAKE, SSE (REF. 2,4,5,7,9,23,27,30,33,49)

CONSEQUENCE
* Nil to complete loss of vessel contents

FREQUENCY
* 1.00E-04 to 1.00E-06 per year

SAFETY FEATURES
* All new facilities to be designed and constructed to maintain functional integrity in an earthquake producing ground acceleration of 20 percent of the acceleration of gravity (0.2 g) at zero period (corresponds to MM VIII earthquake).

1.01.02. HURRICANE (REF. 2,4,5,9,22,23,25-27,30,50)

FREQUENCY
* 3.00E-06 to 5.00E-08 per hour

CONSEQUENCE
* Breach of containment
* Contamination of environment

SAFETY FEATURES
* Stack located far enough from important structures to avoid damage to buildings in case of collapse
* Processing area to conform to maximum resistance design criteria
* Holddowns on vulnerable equipment
* Emergency power system protection

NOTE: The remainder of the databank is available on request from any of the authors.

SRL INCIDENTS DATABANK

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3.01.37 ADVERSE WINTER OPERATING CONDITIONS
3.01.38 ADVERSE EFFECTS OF LIGHTNING
3.01.39 SABOTAGE
3.01.40 TORNADO

3.0 SPECIFIC INCIDENTS FOR WASTE SOLIDIFICATION (CONTINUED)

3.02 EVAPORATION AND SALT SOLIDIFICATION——————(I0302)

3.02.01 OVERFLOW OF EVAPORATOR CELL
3.02.02 RELEASE DURING EQUIPMENT REMOVAL
3.02.03 RELEASE FROM SEGREGATED WATER
3.02.04 LEAK THROUGH EVAPORATOR CELL
3.02.05 OVERFLOW OF OVERHEADS TANK
3.02.06 EVAPORATOR EXPLOSION
3.02.07 CHEMICAL OXIDATION OF RUTHENIUM TO VOLATILE RUTHENIUM TETROXIDE
3.02.08 LOSS OF COOLING WATER
3.02.09 LOSS OF ELECTRIC POWER
3.02.10 LOSS OF INSTRUMENT OR PROCESS COMPRESSED AIR
3.02.11 EVAPORATOR ERUCTATION
3.02.12 EVAPORATOR LEAK
3.02.13 MAJOR LIQUID RELEASE FROM WASTE TANK RISER
3.02.14 OVERFLOW OF CONCENTRATE TRANSFER SYSTEM (CTS) PIT
3.02.15 CONCENTRATE TRANSFER SYSTEM (CTS) TANK EXPLOSION
3.02.16 SPILL FROM CONCENTRATE TRANSFER SYSTEM (CTS) CLEANOUT PORT
3.02.17 ERRONEOUS TRANSFER OF EVAPORATOR MATERIALS
3.02.18 SUCKBACK
3.02.19 DAMAGE FROM EQUIPMENT DROPPED DURING HANDLING
3.02.20 COLLAPSE OF SALT CAKE STORAGE TANK
3.02.21 EARTHQUAKE GREATER THAN MM VIII
3.02.22 METEORITE
3.02.23 AIRCRAFT CRASH
3.02.24 FLOODING FROM RIVER
3.02.25 VOLCANO
3.02.26 ADVERSE WINTER OPERATING CONDITIONS
3.02.27 ADVERSE EFFECTS OF LIGHTNING

3.03 ALUMINUM DISSOLVING——————(I0303)

3.03.01 EXPLOSION IN THE OFF-GAS SYSTEM
3.03.02 PRESSURIZATION OF THE DISSOLVER
3.03.03 DISSOLVER POT COILS NOT SUBMERGED DURING SHUTDOWN
3.03.04 HIGH LIQUID LEVEL IN DISSOLVER

3.04 CENTRIFUGATION——————(I0304)

3.04.01 SEVERE VIBRATION OF CENTRIFUGE
3.04.02 CENTRIFUGE MISSILE
3.04.03 EXCESSIVE CAKE COMPACTION
3.04.04 FAILURE OF CENTRIFUGE SUSPENSION SYSTEM
3.04.05 CENTRIFUGE PLOW BREAKS
3.04.06 CRITICALITY

3.05 SAND FILTRATION——————(I0305)

3.05.01 OVERFLOW OF SAND FILTER
3.05.02 FIRE IN OR AROUND SAND FILTER
3.05.03 HYDRAULIC SURGE
3.05.04 FAILURE OF BACKFLUSH SYSTEM TO OPERATE
3.05.05 INTRODUCTION OF NITRIC ACID INTO CAUSTIC AND AMMONIA BEARING STREAMS
3.05.06 CRITICALITY

3.0 SPECIFIC INCIDENTS FOR WASTE SOLIDIFICATION (CONTINUED)

3.06 SLUDGE-SUPERNATE SEPARATION - GENERAL (I0306)

3.06.01 TRANSFER ERROR
3.06.02 VESSEL OVERFLOW
3.06.03 TRANSFER LINE PLUGGAGE
3.06.04 VESSEL AND LINE LEAKAGE
3.06.05 SUCKBACK
3.06.06 SIPHONING
3.06.07 COIL FAILURE
3.06.08 VESSEL OR PIPING RUPTURE FROM IMPACT OF DROPPED EQUIPMENT
3.06.09 FIRE
3.06.10 CHEMICAL ADDITION ERROR
3.06.11 UNCONTROLLED CHEMICAL REACTIONS
3.06.12 TOTAL LOSS OF COOLING CAPABILITY
3.06.13 INSTRUMENT LINE PLUGGAGE
3.06.14 RELEASE DURING EQUIPMENT REMOVAL
3.06.15 LOSS OF ELECTRIC POWER
3.06.16 LOSS OF INSTRUMENT OR PROCESS COMPRESSED AIR
3.06.17 TEMPERATURE EXCURSION IN SOLIDS SETTLING OUT OF FEED STREAMS
3.06.18 LEAKAGE THROUGH CELL OR CANYON WALL
3.06.19 ADVERSE WINTER OPERATING CONDITIONS
3.06.20 ADVERSE EFFECTS OF LIGHTNING
3.06.21 SABOTAGE
3.06.22 LARGE AIRCRAFT IMPACT
3.06.23 EARTHQUAKE GREATER THAN SAFE SHUTDOWN EARTHQUAKE
3.06.24 METEORITE IMPACT
3.06.25 HURRICANE OR TORNADO GREATER THAN DESIGN BASIS
3.06.26 FLOOD GREATER THAN THE PROBABLE MAXIMUM FLOOD

3.07 SUPERNATE DECONTAMINATION (I0307)

3.07.01 CESIUM BREAKTHROUGH OF DUOLITE COLUMN
3.07.02 PRECIPITATION IN ION EXCHANGE COLUMN
3.07.03 OVERHEATING OF ZEOLITE COLUMN
3.07.04 HIGH TEMPERATURE IN ION EXCHANGE COLUMN
3.07.05 LINE AND SAMPLER PLUGGAGE BY RESIN
3.07.06 UNCONTROLLED REACTION OF RESIN
3.07.07 IMPROPER RESIN LEVEL

3.08 AMMONIA - CARBON DIOXIDE RECOVERY (I0308)

3.08.01 FOAMING IN ELUTRIANT RECOVERY CONCENTRATION REBOILER
3.08.02 PLUGGAGE OF ELUTRIANT RECOVERY CONDENSER
3.08.03 CONTAMINATION OF CESIUM ELUTRIANT MAKEUP WITH CESIUM
3.08.04 AMMONIA COMPOUNDS
3.08.05 OVERHEATING OF CONCENTRATOR REBOILER
3.08.06 CONCENTRATOR OVERPRESSURIZATION
3.08.07 PLUGGAGE OF ELUTRIANT RECOVERY VENT SYSTEM

3.09 RECYCLE CONCENTRATION (I0309)

3.09.01 ACCUMULATION OF ION EXCHANGE RESIN IN EVAPORATOR
3.09.02 EVAPORATOR LEAKAGE
3.09.03 EXPLOSION IN RECYCLE EVAPORATOR

3.0 SPECIFIC INCIDENTS FOR WASTE SOLIDIFICATION (CONTINUED)

3.10 SUPERNATE TREATMENT (GENERAL)——————————(I0310)

3.10.01 TRANSFER ERROR
3.10.02 OVERFLOW
3.10.03 TRANSFER LINE PLUGGAGE
3.10.04 INSTRUMENT LINE PLUGGAGE
3.10.05 VESSEL AND LINE LEAKAGE
3.10.06 SUCKBACK
3.10.07 COIL FAILURE
3.10.08 RUPTURE BY EXTERNALLY INDUCED IMPACT
3.10.09 FIRE
3.10.10 CHEMICAL ADDITION ERROR
3.10.11 UNCONTROLLED CHEMICAL REACTION
3.10.12 TOTAL LOSS OF COOLING CAPABILITY
3.10.13 RELEASE DURING EQUIPMENT REMOVAL
3.10.14 LOSS OF ELECTRIC POWER
3.10.15 LOSS OF INSTRUMENT AIR
3.10.16 SECONDARY CONTAINMENT LEAKAGE
3.10.17 CRITICALITY
3.10.18 SIPHONING
3.10.19 SABOTAGE
3.10.20 LARGE AIRCRAFT IMPACT
3.10.21 EARTHQUAKE GREATER THAN SAFE SHUTDOWN
3.10.22 METEORITE IMPACT
3.10.23 STRONG WIND
3.10.24 FLOOD GREATER THAN PROBABLE MAXIMUM FLOOD
3.10.25 ADVERSE WINTER OPERATING CONDITIONS
3.10.26 LIGHTNING

3.11 CALCINING——————————————————————(I0311)

3.11.01 HIGH TEMPERATURE BREACH OF THE CALCINER
3.11.02 CALCINER BREACHED FROM INTERNAL CORROSION
3.11.03 CALCINER BREACHED FROM THERMAL SHOCK
3.11.04 CALCINER BREACHED FROM PRESSURIZATION
3.11.05 CALCINER BREACHED FROM IMPACT
3.11.06 BY-PASS OR FAILURE OF SINTERED METAL FILTERS
3.11.07 HEPA FILTER SYSTEM BREACHED
3.11.08 ENERGETIC AIRBORNE RELEASE
3.11.09 HIGH RUTHENIUM ADSORBER BED TEMPERATURE
3.11.10 INCREASED VOLATILIZATION OF RUTHENIUM TETRAOXIDE AND LOCALIZED RUTHENIUM DIOXIDE DEPOSITION
3.11.11 EXCESSIVE SOLVENT OXIDATION IN CALCINER
3.11.12 ABNORMAL NITRATE AND/OR WATER IN CALCINE

3.12 CONTINUOUS GLASS MELTING——————————————(I0312)

3.12.01 STEAM EXPLOSION
3.12.02 REFRACTORY COLLAPSE OR SPALLING
3.12.03 ELECTRICAL SHORTING
3.12.04 MAJOR GLASS SPILL
3.12.05 CRITICALITY
3.12.06 PLUGGAGE
3.12.07 RELEASE OF AIRBORNE ACTIVITY TO CELL OR VENTILATION SYSTEM

3.0 SPECIFIC INCIDENTS FOR WASTE SOLIDIFICATION (CONTINUED)

3.13 MECHANICAL CELL ——— (I0313)

3.13.01 FAILURE OF HIGH-LEVEL WASTE CANISTER

3.14 SLUDGE TREATMENT (GENERAL) ——— (I0314)

3.14.01 TRANSFER ERROR
3.14.02 VESSEL OVERFLOW
3.14.03 TRANSFER LINE PLUGGAGE
3.14.04 VESSEL AND LINE LEAKAGE
3.14.05 SUCKBACK
3.14.06 SIPHONING
3.14.07 COIL FAILURE
3.14.08 VESSEL OR PIPING RUPTURE FROM IMPACT OF DROPPED EQUIPMENT
3.14.09 FIRE
3.14.10 CHEMICAL ADDITION ERROR
3.14.11 UNCONTROLLED CHEMICAL REACTIONS
3.14.12 TOTAL LOSS OF COOLING CAPABILITY
3.14.13 INSTRUMENT LINE PLUGGAGE
3.14.14 RELEASE DURING EQUIPMENT REMOVAL
3.14.15 LOSS OF ELECTRIC POWER
3.14.16 LOSS OF INSTRUMENT OR PROCESS COMPRESSED AIR
3.14.17 TEMPERATURE EXCURSION IN SOLIDS SETTLING OUT OF FEED STREAMS
3.14.18 LEAKAGE THROUGH CELL OR CANYON WALL
3.14.19 LARGE AIRCRAFT IMPACT
3.14.20 EARTHQUAKE GREATER THAN SAFE SHUTDOWN EARTHQUAKE
3.14.21 METEORITE IMPACT
3.14.22 HURRICANE OR TORNADO GREATER THAN DESIGN BASIS
3.14.23 FLOOD GREATER THAN PROBABLE MAXIMUM FLOOD
3.14.24 ADVERSE WINTER OPERATING CONDITIONS
3.14.25 ADVERSE AFFECTS OF LIGHTNING
3.14.26 SABOTAGE

3.15 CRANE OPERATIONS ——— (I0315)

3.15.01 CONTAMINATION IN CRANE CAB
3.15.02 CONTAMINATION OF CRANE EXTERNAL TO CAB
3.15.03 CONTAMINATION OF WORK AREAS BY CRANE OPERATIONS (MISHANDLING)
3.15.04 DISENGAGEMENT FROM CRANE HOOK
3.15.05 OPERATOR MISHANDLING OF CRANE (DAMAGE TO EQUIPMENT BY MISHANDLING OF CRANE)
3.15.06 CRANE CABLE DAMAGE
3.15.07 FAILURE OF CRANE COMPONENTS

8.0 SPECIFIC INCIDENTS FOR WASTE SOLIDIFICATION (CONTINUED)

8.16 ELECTRICAL POWER SUPPLY——————————(I0316)

8.16.01 LOSS OF NORMAL ELECTRICAL POWER TO SUBSTATION FOR AREA
8.16.02 FAILURE TO SUPPLY NORMAL ELECTRICAL POWER TO AREA SUBSTATION SWITCHGEAR
8.16.03 FAILURE TO SUPPLY NORMAL ELECTRICAL POWER TO AREA LOOP
8.16.04 FAILURE TO SUPPLY NORMAL ELECTRICAL POWER TO SECONDARY FEEDERS
8.16.05 FAILURE TO SUPPLY ELECTRICAL POWER TO SECONDARY FEEDER TRANSFORMER
8.16.06 FAILURE TO SUPPLY POWER TO A MOTOR CONTROL CENTER
8.16.07 FAILURE TO SUPPLY POWER TO OPERATING EQUIPMENT
8.16.08 FAILURE OF EMERGENCY DIESEL GENERATOR SYSTEM

8.17 WATER SUPPLY AND RETURN——————————(I0317)

8.17.01 FAILURE OF WELL PUMP
8.17.02 COOLING TOWER SYSTEM FAILURE
8.17.03 PUMP SYSTEM FAILURE BY FREEZING
8.17.04 FAILURE OF NORMAL COOLING WATER
8.17.05 FAILURE OF HEAT EXCHANGER
8.17.06 RECIRCULATING COOLING-WATER RETURN-PUMP FAILURE
8.17.07 CLOSED-LOOP COOLING WATER CONTAMINATION
8.17.08 RADIOACTIVE LEAKAGE THROUGH COOLING WATER TO THE ENVIRONMENT

8.18 STEAM GENERATION AND DISTRIBUTION——————(I0318)

8.18.01 LEAK IN STEAM OR COOLING COIL WITHIN PROCESS VESSEL
8.18.02 HIGH STEAM PRESSURE IN PROCESS EQUIPMENT
8.18.03 FAILURE OF STEAM SUPPLY

8.19 COLD FEED FACILITY——————————(I0319)

8.19.01 LEAK
8.19.02 TRANSFER ERROR
8.19.03 OVERFLOW
8.19.04 UNCONTROLLED REACTIONS
8.19.05 CHEMICAL ADDITION ERROR
8.19.06 TRANSFER LINE PLUGGAGE
8.19.07 TANK TRUCK DRIVES OFF BEFORE DISCONNECTION
8.19.08 COLLAPSE OF ATMOSPHERIC PRESSURE STORAGE TANK
8.19.09 LEAKING CONTAINER
8.19.10 CONTAINER MISLABELED OR LABEL ILLEGIBLE
8.19.11 HYDRAZINE PEROXIDE EXPLOSION
8.19.12 OPERATOR EXPOSURE TO DUST OR FUMES
8.19.13 EXPLOSION OF EMPTY DRUM
8.19.14 CONTAMINATION OF RETURNABLE CONTAINER
8.19.15 PIPE BREAKS
8.19.16 LOSS OF INERT ATMOSPHERE IN TANK
8.19.17 WRONG CHEMICAL ADDED TO SOLUBLE POISON TANK
8.19.18 RADIOACTIVITY IN RECYCLE WATER AND/OR ACID USED IN MAKEUP
8.19.19 PROCESS SOLUTIONS IN COLD CHEMICAL AREA
8.19.20 CHEMICAL DELIVERED TO WRONG PROCESS VESSEL
8.19.21 COLD CHEMICAL LEAKS TO PROCESS

3.0 SPECIFIC INCIDENTS FOR WASTE SOLIDIFICATION (CONTINUED)

3.20 SAMPLING OPERATIONS (I0320)

3.20.01 BROKEN SAMPLE VIAL
3.20.02 LEAK
3.20.03 FAILURE TO SURVEY PERSON OR MATERIAL PRIOR TO REMOVAL FROM SAMPLE AISLE
3.20.04 FIRE
3.20.05 IMPROPER STORAGE OF WASTES OR EQUIPMENT
3.20.06 HOIST FAILURE
3.20.07 OPERATOR ERROR
3.20.08 PLUGGAGE OF SAMPLER NEEDLE
3.20.09 RADIATION EXPOSURE TO PERSONNEL
3.20.10 AIR REVERSAL
3.20.11 FAILURE TO OBTAIN SAMPLE OR ANALYSIS, OR DELAYED ANALYSIS
3.20.12 SPILL
3.20.13 CONTAMINATION THROUGH EXPANSION JOINTS
3.20.14 INJURY TO PERSONNEL
3.20.15 SAMPLER PRESSURIZED

3.21 VENTILATION SYSTEMS (I0321)

3.21.01 LOSS OF STACK CONDENSATE TO ENVIRONMENT
3.21.02 FAILURE OF STACK SAMPLING AND MONITORING SYSTEMS
3.21.03 SAND FILTER DEPRESSION
3.21.04 WATER ACCUMULATION IN THE SAND FILTER
3.21.05 CANYON EXHAUST FAN FAILURE
3.21.06 CIRCUIT BREAKER SWITCH FAILED
3.21.07 POWER FAILURE TO MOTOR OF AIR EXHAUST FAN
3.21.08 VACUUM LOST IN PROCESS VESSEL VENT SYSTEM
3.21.09 DAMPER FAILURE
3.21.10 MECHANICAL FAILURE OF FAN IN PROCESS VESSEL VENT SYSTEM
3.21.11 ELECTRIC POWER FAILURE IN THE PROCESS VESSEL VENT SYSTEM
3.21.12 HIGH RUTHENIUM ADSORBER BED TEMPERATURE
3.21.13 HEPA FILTER LEAKAGE IN MELTER-CALCINER OFF-GAS SYSTEM
3.21.14 HIGH PRESSURE DROP ACROSS HEPA FILTERS
3.21.15 FILTER PLUGGAGE IN THE PROCESS VESSEL VENT SYSTEM
3.21.16 AIR REVERSAL
3.21.17 EARTHQUAKE AND TORNADO
3.21.18 STACK FAILURE
3.21.19 LOSS OF BUILDING VENTILATION
3.21.20 RADIOACTIVE CONTAMINATION OF BUILDING VENTILATION AIR
3.21.21 CHEMICAL CONTAMINATION OF BUILDING AIR
3.21.22 HEPA FILTER FAILURE OR DEGREDATION

3.22 GANG VALVE OPERATIONS (I0322)

3.22.01 FIRE
3.22.02 RADIATION EXPOSURE TO PERSONNEL (SEVERE POTENTIAL RADIATION EXPOSURE TO PERSONNEL)
3.22.03 MECHANICAL OR ELECTRICAL FAILURE OF A GANG VALVE
3.22.04 INJURY TO PERSONNEL
3.22.05 SUCKBACK
3.22.06 LEAK
3.22.07 TRANSFER ERROR
3.22.08 FAILURE TO SURVEY PERSON OR MATERIAL PRIOR TO REMOVAL FROM GANG VALVE CORRIDOR

8.0 SPECIFIC INCIDENTS FOR WASTE SOLIDIFICATION (CONTINUED)

8.23 SHOPS AND DECONTAMINATION FACILITIES——————(I0323)

8.23.01 TRANSFER ERROR OF CONTAMINATED SOLUTIONS
8.23.02 OVERFLOW OF CONTAMINATED DECONTAMINATION SOLUTION
8.23.03 LEAK OF CONTAMINATED MATERIALS
8.23.04 PERSONNEL EXPOSURE TO RADIATION
8.23.05 AIRBORNE ACTIVITY IN SHOPS AND DECONTAMINATION CELL

8.24 COMPRESSED AIR AND COMPRESSED GAS SYSTEMS——————(I0324)

8.24.01 PLANT AIR SYSTEM FAILURE
8.24.02 INSTRUMENT AIR SYSTEM FAILURE
8.24.03 PROCESS AIR SYSTEM FAILURE
8.24.04 BREATHING AIR SYSTEM FAILURE
8.24.05 FIRE

4.0 INCIDENTS FOR HB-LINE OPERATIONS (SRP)——————(I0400)

4.01 CABINETS——————(I0401)

4.01.01 CRITICALITY
4.01.02 FIRE IN CABINET
4.01.03 GLOVE FAILURE
4.01.04 HIGH RADIATION EXPOSURE TO OPERATING PERSONNEL
4.01.05 SEVERE IMPACT TO CABINET PANELS
4.01.06 LEAK THROUGH GLOVE BOX GASKETS
4.01.07 MIGRATION OF RADIOACTIVITY FROM GLOVE BOX TO COLD FEED
4.01.08 RUPTURE OF AIR LINES TO AUTOMATIC VALVES
4.01.09 FAILURE OF SERVICE CONNECTIONS TO GLOVE BOX
4.01.10 OVERFLOW OF BUCKET USED TO CATCH LEAK
4.01.11 LEAKING SAMPLE
4.01.12 TAPE ON CABINET EDGES PEELS OFF
4.01.13 DAMAGE TO CABINET PANELS
4.01.14 DAMAGE TO BASEBORDS OR MOLDING
4.01.15 LOSS OF CABINET VACUUM

4.02 PERSONNEL——————(I0402)

4.02.01 SKIN AND CLOTHING CONTAMINATION
4.02.02 NASAL CONTAMINATION
4.02.03 INJURY
4.02.04 FAILURE TO MONITOR

4.03 ROOMS——————(I0403)

4.03.01 AIRBORNE RADIOACTIVITY PRESENT - PRODUCT REMOVAL
4.03.02 AIRBORNE RADIOACTIVITY PRESENT - FILTER CHANGE
4.03.03 AIRBORNE RADIOACTIVITY PRESENT - SUIT REMOVAL
4.03.04 AIRBORNE RADIOACTIVITY PRESENT - TILE REPLACEMENT
4.03.05 AIRBORNE RADIOACTIVITY PRESENT - TORN CONTAMINATED FILTER BAGS
4.03.06 AIRBORNE RADIOACTIVITY PRESENT - WASTE REBAGGING
4.03.07 AIRBORNE RADIOACTIVITY PRESENT - NORMAL MAINTENANCE
4.03.08 AIRBORNE RADIOACTIVITY PRESENT - INADEQUATE HUT CONSTRUCTION OR AIR FLOW
4.03.09 AIRBORNE RADIOACTIVITY PRESENT - HUT REMOVAL
4.03.10 AIRBORNE RADIOACTIVITY PRESENT - WASTE REMOVAL
4.03.11 AIRBORNE RADIOACTIVITY PRESENT - GLOVE CHANGE
4.03.12 AIRBORNE RADIOACTIVITY PRESENT - SAMPLING OPERATIONS
4.03.13 AIRBORNE RADIOACTIVITY PRESENT - DECONTAMINATION
4.03.14 CONSTANT AIR MONITOR FAILURE
4.03.15 GENERAL SURFACE CONTAMINATION
4.03.16 CONTAMINATION FROM REGULATED TOILET FACILITIES
4.03.17 LEAKAGE OF WASTE CONTAINER ON LOADING DOCK

4.04 SUMPS——————(I0404)

4.04.01 OVERFLOW OF CABINET SUMP
4.04.02 SUMP LEAK
4.04.03 FAILURE OF SUMP PROBE
4.04.04 CRITICALITY IN SUMP

4.0 INCIDENTS FOR HB-LINE OPERATIONS (SRP) (CONTINUED)

4.05 NATURAL PHENOMENA (I0405)

4.05.01 DESIGN BASIS EARTHQUAKE
4.05.02 DESIGN BASIS TORNADO

4.06 COLD FEED (I0406)

4.06.01 UNCONTROLLED REACTIONS
4.06.02 CHEMICAL ADDITION ERROR
4.06.03 OVERFLOW
4.06.04 TRANSFER ERROR
4.06.05 BACKUP OF MATERIAL INTO COLD FEED AREA
4.06.06 TRANSFER LINE PLUGGAGE
4.06.07 TRANSFER PUMP FAILURE
4.06.08 EQUIPMENT AND PIPING LEAKS.

4.07 ELECTRICAL (I0407)

4.07.01 LOSS OF NORMAL ELECTRICAL POWER TO SUBSTATION FOR H-AREA
4.07.02 FAILURE TO SUPPLY ELECTRICAL POWER TO AREA SUBSTATION SWITCH GEAR
4.07.03 FAILURE TO SUPPLY NORMAL ELECTRICAL POWER TO AREA LOOP
4.07.04 FAILURE TO SUPPLY NORMAL ELECTRICAL POWER TO SECONDARY FEEDERS
4.07.05 FAILURE TO SUPPLY ELECTRICAL POWER TO SECONDARY FEEDER TRANSFORMER
4.07.06 FAILURE TO SUPPLY POWER TO A MOTOR CONTROL CENTER
4.07.07 FAILURE TO SUPPLY POWER TO VITAL OPERATING EQUIPMENT
4.07.08 FAILURE OF EMERGENCY DIESEL GENERATOR SYSTEM
4.07.09 CORRODED AND FRAYED ELECTRICAL WIRING AND RECEPTICALS

4.08 FIRE/FIRE EQUIPMENT (I0408)

4.08.01 UNWANTED ACTIVATION OF HALON SYSTEM
4.08.02 FAILURE OF SMOKE DETECTOR SOCKETS
4.08.03 FAILURE OF FIRE ALARM IN 221-H CONTROL ROOM

4.09 HEATING AND COOLING WATER SUPPLY (I0409)

4.09.01 FAILURE OF WELL PUMP
4.09.02 COOLING TOWER FAILURE
4.09.03 PUMP SYSTEM FAILURE BY FREEZING
4.09.04 FAILURE OF NORMAL COOLING WATER
4.09.05 FAILURE OF HEAT EXCHANGER
4.09.06 RECIRCULATING COOLING WATER RETURN PUMP FAILED
4.09.07 LEAK ON COOLING WATER LINE TO CONDENSER IN VACUUM TRANSFER SYSTEM
4.09.08 LOSS OF COOLING CAPABILITY IN WATER SYSTEM
4.09.09 FAILURE OF HOT WATER HEATING ELEMENT

4.0 INCIDENTS FOR HB-LINE OPERATIONS (SRP) (CONTINUED)

4.10 VACUUM ——— (I0410)

4.10.01 CONTAMINATION OF CIRCULATED COOLING WATER SYSTEM
4.10.02 PLUGGAGE OF LINES TO VACUUM SYSTEMS
4.10.03 FAILURE OF CATCH TANK LIQUID LEVEL INSTRUMENT
4.10.04 CHECK VALVE OR DRAIN VALVE FAILURE
4.10.05 LOW VACUUM
4.10.06 VACUUM PUMP FAILURE

4.11 VENTILATION ——— (I0411)

4.11.01 CANYON EXHAUST FAN FAILURE WHILE B-LINE FANS OPERATE
4.11.02 FIRE ON FILTERS
4.11.03 LEAKAGE OF HEPA FILTERS
4.11.04 FAILURE OF GLOVE BOX EXHAUSTERS
4.11.05 FAILURE OF ROOM EXHAUST FANS
4.11.06 VESSEL VENT BOOSTER FAILURE
4.11.07 PLUGGAGE OF VESSEL VENT SYSTEM
4.11.08 FAILURE OF STACK MONITOR
4.11.09 LEAKS FROM VESSEL VENT SCRUBBER TANKS
4.11.10 CORROSION OF EXHAUST DUCTS FROM COLD FEED PREP
4.11.11 SUPPLY FAN FAILURE
4.11.12 BREATHING AIR SYSTEM FAILURE
4.11.13 FUME RRELEASE FROM USED FILTERS
4.11.14 PLUGGAGE OF VENTILATION FILTERS
4.11.15 FAILURE OF HEPA FILTER CRANK-OUT MECHANISM
4.11.16 HIGH PRESSURE DROP ACROSS THE HIGH EFFICIENCY PARTICULATE AIR FILTERS
4.11.17 CONTAMINATION OF INSTRUMENT AND BREATHING AIR COMPRESSORS
4.11.18 DAMPER FAILURE
4.11.19 WATER ACCUMULATION IN SAND FILTER
4.11.20 SAND FILTER DEPRESSION

4.12 DISSOLVING ——— (I0412)

4.12.01 HYDROGEN EXPLOSION
4.12.02 UNCONTROLLED CHEMICAL REACTION IN DISSOLVER
4.12.03 DISSOLVER COMPONENT FAILURES
4.12.04 HIGH NEUTRON RADIATION
4.12.05 LOSS OF CONDENSER COOLING CAPACITY
4.12.06 CONDENSER OVERLOAD
4.12.07 CONTAMINATION OF REFRIGERATION UNIT
4.12.08 TRANSFER ERROR
4.12.09 VESSEL OVERFLOW

4.13 ION EXCHANGE ——— (I0413)

4.13.01 UNCONTROLLED REACTION BETWEEN NITRIC ACID AND ANION EXCHANGE RESIN
4.13.02 ION EXCHANGE RESIN FIRE
4.13.03 OVERFLOW OF COLUMN
4.13.04 TRANSFER LINE PLUGGAGE BY ION EXCHANGE RESIN
4.13.05 LEAKAGE TO CABINETS
4.13.06 IMPROPER RESIN LEVEL
4.13.07 PRECIPITATION IN ION EXCHANGE COLUMN
4.13.08 CRITICALITY IN CONCENTRATE TANK
4.13.09 CLOSED LOOP COOLING WATER CONTAMINATION

4.0 INCIDENTS FOR HB-LINE OPERATIONS (SRP) (CONTINUED)

4.14 PRECIPITATION ——— (I0414)

4.14.01 OVERFLOW OF PRECIPITATORS
4.14.02 LEAKAGE TO CABINETS
4.14.03 PLUGGAGE OF TRANSFER LINES
4.14.04 FAILURE OF SAMPLER ASSEMBLY
4.14.05 SIGNIFICANT SAMPLER ANALYSIS DISAGREEMENT
4.14.06 CHEMICAL ADDITION ERROR
4.14.07 UNCONTROLLED REACTION
4.14.08 CLOSED LOOP COOLING WATER CONTAMINATION

4.15 FILTRATION ——— (I0415)

4.15.01 HIGH LOSS OF PRODUCT TO FILTRATE
4.15.02 SLOW FILTRATION
4.15.03 SPILLAGE OF FILTER BOAT CONTENTS
4.15.04 LEAKAGE TO CABINETS
4.15.05 PLUGGAGE OF TRANSFER LINES
4.15.06 VACUUM GAUGE FAILURE
4.15.07 FAILURE OF SAMPLER ASSEMBLY
4.15.08 CRITICALITY IN FILRRATE/CONCENTRATE/RECYCLE TANK
4.15.09 FILTRATION WITHOUT A FILTER BOAT

4.16 THERMAL PROCESSES ——— (I0416)

4.16.01 HIGH TEMPERATURE BREECH OF CALCINER
4.16.02 CALCINER BREACHED FROM INTERNAL CORROSION
4.16.03 BY-PASS OF SINTERED METAL FILTERS
4.16.04 HEPA FILTER SYSTEM BREACHED
4.16.05 POWDER EXPELLED FROM FILTER BOAT
4.16.06 FOAMING INSIDE FILTER BOAT DURING CALCINATION
4.16.07 FAILURE OF FURNACE EXHAUST SYSTEM

4.17 PACKAGING AND FINISHING ——— (I0417)

4.17.01 FAILURE TO INSPECT SHIPPING BOTTLE

4.18 FILTRATE TANKS ——— (I0418)

4.18.01 LEAKAGE TO CABINETS
4.18.02 PLUGGAGE OF TRANSFER LINES
4.18.03 VACUUM GAGE FAILURE
4.18.04 FAILURE OF SAMPLER ASSEMBLY

4.0 INCIDENTS FOR HB-LINE OPERATIONS (SRP) (CONTINUED)

4.19 PRODUCT TANKS (I0419)

4.19.01 LEAKAGE TO CABINETS
4.19.02 PLUGGAGE OF TRANSFER LINES
4.19.03 SIPHONING
4.19.04 FAILURE OF SAMPLER ASSEMBLY
4.19.05 SIGNIFICANT SAMPLE ANALYSIS DISAGREEMENT

4.20 CONTAINERS (I0420)

4.20.01 INADEQUATE WELD PENETRATION OF PRODUCT SHIPPING CONTAINERS
4.20.02 CORROSION OF CONTAINERS FROM LONG TERM STORAGE
4.20.03 CONTAMINATED CONTAINERS RECEIVED INTO B-LINE
4.20.04 UNAUTHORIZED REMOVAL OF CONTAINERS FROM HOOD
4.20.05 INABILITY TO REMOVE CAP FROM CONTAINER IN A NORMAL MANNER
4.20.06 REDUCED CRITICALLY MARGIN

4.21 MISCELLANEOUS (I0421)

4.21.01 FAILURE OF RUSTRACK ALARM
4.21.02 URANIUM SCRAP FOR JB-LINE SENT TO HB-LINE
4.21.03 FAILURE OF COMBINATION LOCK TO DOOR
4.21.04 FAILURE TO POST FISSILE EMBLEMS OR NUCLEAR SAFETY LINITS ON DOOR
4.21.05 FAILURE OF PHA
4.21.06 RELEASE OF RADIOACTIVITY MATERIALS THROUGH MOP WATER

5.0 SPECIFIC INCIDENTS FOR INTEGRATED HOT OFF-GAS FACILITY (IHOG)——(I0500)

5.01 RUTHENIUM REMOVAL——(I0501)

5.01.01 HIGH RUTHENIUM BED TEMPERATURE
5.01.02 DOG HEADER PLUGGAGE IN CANYON
5.01.03 TEMPERATURE INSTRUMENT FAILURE
5.01.04 HIGH DOG HEADER PRESSURE
5.01.05 PLUGGAGE OF RUTHENIUM TRAP
5.01.06 INADEQUATELY (LESS THAN 90 DAYS) COOLED FUEL
5.01.07 ERUCTATION OF DISSOVER
5.01.08 DISSOLVER HEATING COILS NOT SUBMERGED
5.01.09 RUTHUNIUM ESCAPES TO DOG SYSTEM

5.02 ACID SCRUBBER——(I0502)

5.02.01 NOX ABSORBER FLOODED
5.02.02 INADEQUATE ABSORBER IN NOX COLUMN
5.02.03 FAILURE TO COOL PROCESS GAS BETWEEN RUTHENIUM BED AND
5.02.04 IODINE PLATEOUT ON SCRUBBER PRE-COOLER

5.03 NOX DESTRUCTOR——(I0503)

5.03.01 HEATER FAILURE
5.03.02 FORMATION OF AMMONIUM COMPOUNDS

5.04 IODINE REMOVAL——(I0504)

5.04.01 LOSS OF TEMPERATURE CONTROL
5.04.02 AGZ BED OVERLOAD
5.04.03 AGZ BED POISONED OR PLUGGED
5.04.04 FAILURE OF IODINE ABSORPTION OFF-GAS MONITOR OR ANALYZER
5.04.05 RUPTURE OF AGZ BED
5.04.06 FORMATION OF AMMONIUM IODIDE OR AMMONIUM TRIIODIDE IN NOX
5.04.07 EXPLOSION IN REGENERATION SYSTEM

5.05 CARBON REMOVAL——(I0505)

5.05.01 DEGRADATIOIN OF BED CAPACITY

5.06 TRITIUM REMOVAL——(I0506)

5.06.01 GAS COOLER FAILURE
5.06.02 TEMPERATURE INSTRUMENT FAILURE
5.06.03 TRITIUM LEAK TO HOOD
5.06.04 ABSORBER BED OVERLOAD
5.06.05 REGENERATOR HEATER LEFT ON WITHOUT FLOW

5.0 SPECIFIC INCIDENTS FOR INTEGRATED HOT OFF-GAS FACILITY (IHOG) (CONTINUED)

5.07 KRYPTON RECOVERY ——— (I0507)

5.07.01 FAILURE OF KRYPTON STORAGE
5.07.02 FAILURE OF KRYPTON ABSORBER
5.07.03 KRYPTON RECOVERY SYSTEM LEAKS
5.07.04 MALFUNCTION IN FEED GAS TREATMENT
5.07.05 KRYPTON CYCLINDER OVERFILLED
5.07.06 KRYPTON COMPRESSOR FAILURE
5.07.07 TEMPERATURE INSTRUMENT FAILURE
5.07.08 FAILURE OF SOLVENT REMOVAL SYSTEM(S)
5.07.09 FAILURE OF FINAL OXYGEN REMOVAL SYSTEM

5.08 PROCESS SYSTEMS, GENERAL ——— (I0508)

5.08.01 FIRE IN HOOD
5.08.02 HIGH RADIATION EXPOSURE TO OPERATING PERSONNEL
5.08.03 SEVERE IMPACT TO HOOD PANELS
5.08.04 LEAK THROUGH HOOD GASKETS
5.08.05 VALVE FAILURE
5.08.06 PROCESS SYSTEM LEAKS (LIQUID)
5.08.07 LEAK OF PROCESS GAS TO HOOD
5.08.08 HEATING COIL FAILURE
5.08.09 CHILLED WATER COIL FAILURE
5.08.10 PROCESS PUMP FAILURE
5.08.11 SYSTEM PLUGGAGER
5.08.12 TRANSFER ERRORS
5.08.13 RUPTURE OF AIR LINES TO AUTOMATIC VALVES
5.08.14 FAILURE OF SERVICE CONNECTIONS TO HOOD
5.08.15 VESSEL OVERFLOW
5.08.16 SIPHONING
5.08.17 SIGNIFICANT SAMPLE ANALYSIS DISAGREEMENT
5.08.18 OVERFLOW OF CABINET SUMPS
5.08.19 SUMP LEAK
5.08.20 FAILURE OF SUMP LIQUID LEVEL PROBE
5.08.21 CHEMICAL ADDITION ERROR

5.0 SPECIFIC INCIDENTS FOR INTEGRATED HOT OFF-GAS FACILITY (IHOG) (CONTINUED)

5.09 VENTILATION ——— (I0509)

5.09.01 FIRE ON FILTER
5.09.02 LEAKAGE OF HEPA FILTERS
5.09.03 FAILURE OF HOOD EXHAUSTERS
5.09.04 FAILURE OF ROOM EXHAUST FANS
5.09.05 FAILURE OF STACK MONITOR
5.09.06 CORROSION OF EXHAUST DUCTS
5.09.07 SUPPLY FAN FAILURE
5.09.08 BREATHING AIR SYSTEM FAILURE
5.09.09 FUME RELEASE FROM USED FILTERS
5.09.10 PLUGGAGE OF VENTILATION FILTERS
5.09.11 FAILURE OF HEPA FILTER CRANK-OUT MECHANISM
5.09.12 HIGH PRESSURE DROP ACROSS THE HIGH EFFICIENCY PARTICULATE
5.09.13 CONTAMINATION OF INSTRUMENT AND BREATHING AIR COMPRESSORS
5.09.14 DAMPER FAILURE
5.09.15 WATER ACCUMULATION IN SAND FILTER
5.09.16 SAND FILTER DEPRESSION

5.10 COOLING WATER ——— (I0510)

5.10.01 FAILURE OF WELL PUMP
5.10.02 COOLING TOWER SYSTEM FAILURE
5.10.03 PUMP SYSTEM FAILURE BY FREEZING
5.10.04 FAILURE OF NORMAL COOLING WATER
5.10.05 FAILURE OF HEAT EXCHANGER
5.10.06 RECIRCULATING COOLING WATER RETURN PUMP FAILURE
5.10.07 LOSS OF COOLING CAPACITY IN WATER SYSTEM

5.11 FIRE EQUIPMENT ——— (I0511)

5.11.01 UNWANTED ACTIVATION OF HALON SYSTEM
5.11.02 FAILURE OF SMOKE DETECTOR SOCKETS
5.11.03 FAILURE OF FIRE ALARM IN CONTROL ROOM (221-H)

5.12 PERSONNEL ——— (I0512)

5.12.01 SKIN AND CLOTHING CONTAMINATION
5.12.02 NASAL CONTAMINATION
5.12.03 INJURY
5.12.04 FAILURE TO MONITOR

5.0 SPECIFIC INCIDENTS FOR INTEGRATED HOT OFF-GAS FACILITY (IHOG) (CONTINUED)

5.13 ELECTRICAL ——— (I0513)

5.13.01 LOSS OF NORMAL ELECTRICAL POWER TO SUBSTATION FOR PLANT
5.13.02 FAILURE TO SUPPLY NORMAL ELECTRICAL POWER TO AREA
5.13.03 FAILURE TO SUPPLY NORMAL ELECTRICAL POWER TO AREA LOOP
5.13.04 FAILURE TO SUPPLY NORMAL ELECTRICAL POWER TO SECONDARY
5.13.05 FAILURE TO SUPPLY ELECTRICAL POWER TO SECONDARY FEEDER
5.13.06 FAILURE TO SUPPLY POWER TO MOTOR CONTROL CENTER
5.13.07 FAILURE TO SUPPLY POWER TO VITAL OPERATING EQUIPMENT
5.13.08 FAILURE OF EMERGENCY DIESEL GENERATOR SYSTEM
5.13.09 CORRODED AND FRAYED ELECTRICAL WIRING AND RECEPTICALS

5.14 EXTERNAL PHENOMENA ——— (I0514)

5.14.01 DESIGN BASIS EARTHQUAKE
5.14.02 DESIGN BASIS TORNADO
5.14.03 EXCESSIVELY COLD WEATHER
5.14.04 IMPACT BY EXTERNAL FORCE

5.15 LIQUID AMMONIA ——— (I0515)

5.15.01 LIQUID AMMONIA STORAGE TANK WAS OVERFILLED.
5.15.02 FILLER HOSE WAS LEFT ATTACHED AND WAS BROKEN WHEN TRANSPORT PULLED AWAY.
5.15.03 HOSE-END VALVE WAS KNOCKED OPEN.
5.15.04 PRESSURE RELIEF VALVE WAS VENTED WHILE A PERSON WAS IN LINE WITH THE DISCHARGE.
5.15.05 HOSE BURST DURING TRANSFER
5.15.06 HOSE COUPLING WAS NOT BLED BEFORE IT WAS DISCONNECTED.
5.15.07 CYLINDER WAS DISCONNECTED FROM MANIFOLD WHEN MANIFOLD VALVE WAS OPEN.
5.15.08 UNSECURED CYLINDER BECAME A PROJECTILE WHEN IT TOPPLED AND VALVE WAS KNOCKED OFF.
5.15.09 FAILURE OF A PRESSURIZED STORAGE VESSEL OR GAS CYLINDER. STORAGE VESSEL RUPTURES BECAUSE OF THE UNUSUAL EXPANSION OF LIQUID AMMONIA AND THE RAPID INCREASE OF GAS PRESSURE.
5.15.10 LEAKS (VALVE/REGULATOR, GASKET).

5.0 SPECIFIC INCIDENTS FOR INTEGRATED HOT OFF-GAS FACILITY (IHOG) (CONTINUED)

5.16 AMMONIA DESTRUCTOR ——— (I0516)

5.16.01 EXCESS AMMONIA IN OFF-GAS FROM THE AMMONIA DESTRUCTOR.
5.16.02 CATALYST BED FAILS (REF. 167,168,169)
5.16.03 LOSS OF REDUCTION CAPABILITY OF AMMONIA DESTRUCTOR
5.16.04 FORMATION OF AMMONIUM COMPOUNDS (REF. 171).

5.17 OFF-GAS STORAGE VESSEL ——— (I0517)

5.17.01 STORAGE VESSEL FAILS
5.17.02 OVER-PRESSURIZATION OF THE STORAGE VESSEL
5.17.03 OFF-GAS COMPRESSOR LEAKS
5.17.04 OFF-GAS COMPRESSOR FAILS IN SERVICE
5.17.05 OFF-GAS COMPRESSOR COOLING WATER SYSTEMS FAILS

6.0 INCIDENTS FOR URANIUM FINISHING

6.01 URANYL NITRATE RECEIVING AND STORAGE——————(I0601)

6.01.01 OVERFLOW FROM TANK
6.01.02 TRANSFER ERROR

6.02 URANYL NITRATE EVAPORATION——————————(I0602)

6.02.01 PLUGGAGE OF INSTRUMENT LINES AND SENSORS
6.02.02 STEAM COIL LEAK IN EVAPORATOR REBOILER
6.02.03 COOLING COIL LEAK
6.02.04 OVERFLOW IN CONCENTRATION SYSTEM
6.02.05 FISSILE MATERIAL IN EVAPORATOR CONDENSER
6.02.06 POTENTIAL REACTION BETWEEN TBP AND UNH (RED OIL EXPLOSION) IN PRODUCT EVAPORATOR
6.02.07 LEAK IN CONTAINING CONCENTRATED URANIUM SOLUTION
6.02.08 OVERCONCENTRATION OF URANIUM PRODUCT

6.03 URANIUM DENITRATION (OR CALCINATION)——————(I0603)

6.03.01 DENITRATOR ERUCTATION
6.03.02 PRESSURIZATION OF DENITRATOR
6.03.03 HIGH URANIUM CONCENTRATION IN RECOVERED ACID

6.04 URANIUM REDUCTION——————————————(I0604)

6.04.01 HYDROGEN EXPLOSION
6.04.02 OVERPRESSURIZATION OF REDUCTOR
6.04.03 FIRE IN AMMONIA DISSOCIATOR CUBICLE
6.04.04 REDUCTOR MALFUNCTION

6.05 HYDROFLUORINATION——————————————(I0605)

6.05.01 URANIUM FLUORIDE RELEASE
6.05.02 HYDROFLUORINATOR OVERPRESSURIZATION
6.05.03 HF RELEASE

6.06 FLUORINATION——————————————(I0606)

6.06.01 FLUORINE OR URANIUM FLUORIDE RELEASE
6.06.02 HOLE BURNED IN FLUORINATOR VESSEL
6.06.03 FLUORINATOR OVERPRESSURIZATION
6.06.04 HIGH HF CONCENTRATION IN FLUORINE SUPPLY

6.07 URANIUM HEXAFLUORIDE COLD TRAP AND FLUORINATOR OFF-GAS CLEANING——————(I0607)

6.07.01 URANIUM HEXAFLUORIDE RELEASE FROM SCRUBBER
6.07.02 URANIUM HEXAFLUORIDE RELEASE TO VENT SYSTEM
6.07.03 HIGH PRESSURE IN COLD TRAPS

6.0 INCIDENTS FOR URANIUM FINISHING (CONTINUED)

6.08.01 FAILURE OF A URANIUM HEXAFLUORIDE PRODUCT CYLINDER—(I0608)

6.09 GENERAL - URANIUM HEXAFLUORIDE PRODUCTION——————(I0609)

6.09.01 CRITICALITY POTENTIAL IN URANIUM HEXAFLUORIDE PRODUCTION FACILITY
6.09.02 FIRE
6.09.03 FIRE IN A STACK
6.09.04 URANYL NITRATE SOLUTION LEAKS
6.09.05 URANIUM HEXAFLUORIDE RELEASE
6.09.06 AIRBORNE URANIUM OXIDE

6.10 POWDER HANDLING AND PACKAGING——————————(I0610)

6.10.01 AIRBORNE ACTIVITY IN OPERATING ROOM
6.10.02 ESCAPE OF POWDER FROM CONTAINMENT
6.10.03 FAILURE OF EXHAUST OR SUPPLY FAN MOTOR
6.10.04 AIR REVERSAL
6.10.05 AIRBORNE ACTIVITY DURING FILTER REPLACEMENT
6.10.06 LOADOUT INTO WRONG CONTAINER
6.10.07 POWDER RELEASE FROM BUILDING

6.11 RECYCLE DISSOLUTION——————————————————(I0611)

6.11.01 POWDER SPILL IN OPERATING AREA
6.11.02 COIL LEAK IN DISSOLVER

7.0 SPECIFIC INCIDENTS FOR WASTE HANDLING

7.01 WASTE CALCINATION (HIGH-LEVEL LIQUID WASTE (HLLW) VITRIFICATION)——————(I0701)

7.01.01 HIGH TEMPERATURE BREACH OF THE CALCINER
7.01.02 CALCINER BREACHED FROM INTERNAL CORROSION
7.01.03 CALCINER BREACHED FROM THERMAL SHOCK
7.01.04 CALCINER BREACHED FROM PRESSURIZATION
7.01.05 CALCINER BREACHED FROM IMPACT
7.01.06 EXCESSIVE PENETRATION OF CALCINE THROUGH SINTERED METAL FILTERS
7.01.07 FILTER SYSTEMS BREACHED

7.02 IN-CAN GLASS MELTING——————(I0702)

7.02.01 MELTER BREACHED FROM PRESSURIZATION
7.02.02 MELTER (CAN) BREACHED FROM INTERNAL CORROSION
7.02.03 MELTER BREACHED FROM THERMAL SHOCK
7.02.04 MELTER BREACHED FROM IMPACT
7.02.05 CANISTER BREACHED BY HIGH TEMPERATURE
7.02.06 CANISTER BREACHED BY THERMAL SHOCK
7.02.07 SPILL OF RADIOACTIVE WASTE FROM CANISTER
7.02.08 CRITICALITY
7.02.09 PLUGGAGE OF LINE FROM CALCINER TO MELTER
7.02.10 RELEASE OF AIRBORNE ACTIVITY TO CELL OR VENTILATION SYSTEM
7.02.11 STEAM EXPLOSION
7.02.12 MAJOR GLASS SPILL

7.03 VITRIFIED HIGH-LEVEL WASTE STORAGE——————(I0703)

7.03.01 HIGH ACTIVITY LEVEL IN THE STORAGE POOL WATER
7.03.02 CONTAMINATED CANISTERS
7.03.03 LOSS OF COOLING WATER AND SHIELDING
7.03.04 CANISTER STRESS CORROSION
7.03.05 CANISTERS RAISED ABOVE ADEQUATE SHIELDED LEVEL
7.03.06 WATER LOSS FROM STORAGE POOL
7.03.07 CANISTERS LEAK RADIOACTIVE WASTE
7.03.08 WATER LEAKS INTO THE CANISTER
7.03.09 FIRES IN THE WASTE HANDLING FACILITY
7.03.10 CANISTERS DROPPED DURING HANDLING
7.03.11 RADIOACTIVE RELEASE TO THE BUILDING AIR
7.03.12 RELEASE OF ACTIVITY THROUGH COOLING TOWERS
7.03.13 HEPA FILTER FAILURE

7.0 SPECIFIC INCIDENTS FOR WASTE HANDLING (CONTINUED)

7.04 SOLID WASTE PROCESSING (I0704)

7.04.01 FIRE IN FUEL HARDWARE FIXATION AREA
7.04.02 DRUM OVERFLOW IN FUEL HARDWARE FIXATION AREA
7.04.03 AIRBORNE CEMENT DUST IN GROUT MIXER AREA
7.04.04 RADIOACTIVE CONTAMINATION IN CEMENT PREPARATION AREA (COLD AREA)
7.04.05 EXCESSIVE FISSILE MATERIAL IN HULLS
7.04.06 FAILURE OF CONTAMINATED PROCESS COMPONENTS
7.04.07 WASTE CONTAINER FAILURE AFTER FILLING
7.04.08 DRUMS IMPROPERLY FILLED (NO CEMENT ADDED)
7.04.09 FIRE IN BETA-GAMMA WASTE FACILITY
7.04.10 AIRBORNE ACTIVITY IN THE BETA-GAMMA WASTE FACILITY
7.04.11 VIOLATION OF STACK RELEASE GUIDE
7.04.12 WASTE CONTAINER FAILURE
7.04.13 POWER FAILURE
7.04.14 CRITICALITY POTENTIAL IN ALPHA WASTE
7.04.15 AIRBORNE CEMENT DUST IN GROUT MIXER AREA
7.04.16 RADIOACTIVE CONTAMINATION IN CEMENT PREPARATION AREA (COLD AREA)
7.04.17 WASTE CASK, TRAILER, OR CASK-CAR CONTAMINATED
7.04.18 CASK FALLS FROM TRACTOR TRAILER
7.04.19 CASK CAR UNCOUPLES FROM LOCOMOTIVE (OR RAILROAD CAR PULLER)
7.04.20 CASK TOP STRIKES TRUCK-LOCK DOOR
7.04.21 DAMAGE TO CASK OR HOIST DURING TRANSFER OF CASK FROM
7.04.22 CASK COVER DROPPED
7.04.23 CASK COVER STRUCK
7.04.24 WASTE CONTAINER DAMAGED IN TRANSFER TO CASK
7.04.25 CONTAMINATED WASTE CONTAINER
7.04.26 CRANE DROPS WASTE CONTAINER
7.04.27 CRANE IMMOBILIZED DURING TRANSFER
7.04.28 FAILURE TO REPLACE SHIELDING PLUG IN WASTE CASK
7.04.29 EXCESSIVE GAMMA RADIATION FROM CASK
7.04.30 DERAILMENT OF CAR AND CASK OR OVERTURNING OF TRAILER

7.05 SOLIDIFICATION OF INTERMEDIATE LEVEL LIQUID WASTE (ILLW) (I0705)

7.05.01 FISSILE MATERIAL IN FEED
7.05.02 HIGH-ACTIVITY WASTE IN ILLW SYSTEM
7.05.03 AIRBORNE ACTIVITY
7.05.04 OVERFLOW
7.05.05 OVEREXPOSURE OF PERSONNEL TO RADIATION
7.05.06 MIXER PLUGGAGE
7.05.07 WASTE CONTAINER FAILURE
7.05.08 UNCONTROLLED REACTION IN MIXER OR PRODUCT CONTAINER
7.05.09 POWER FAILURE

8.0 INCIDENTS FOR PLUTONIUM FINISHING

8.01. RECEIPT AND STORAGE ——— (I0801)

8.01.01. OVERFLOW FROM TANK
8.01.02. HYDROGEN EXPLOSION IN STORAGE TANK

8.02. ION EXCHANGE CONCENTRATION ——— (I0802)

8.02.01. UNCONTROLLED REACTION BETWEEN NITRIC ACID AND ION EXCHANGE RESIN IN THE COLUMN
8.02.02. ION EXCHANGE RESIN FIRE
8.02.03. OVERFLOW

8.03. PRECIPITATION ——— (I0803)

8.03.01. CHEMICAL ADDITION ERROR
8.03.02. OVERFLOW OF PRECIPITATOR

8.04. FILTRATION ——— (I0804)

8.04.01. HIGH LOSS OF PRODUCT TO FILTRATE
8.04.02. SPILLAGE OF FILTER BOAT CONTENTS
8.04.03. CRITICALITY IN FILTRATE/CONCENTRATE/RECYCLE TANK

8.05. DRYING AND CALCINATION ——— (I0805

8.05.01. BY-PASS OF SINTERED METAL FILTERS
8.05.02. POWDER EXPELLED FROM FILTER BOAT DURING CALCINATION
8.05.03. FOAMING INSIDE FILTER BOAT DURING CALCINATION
8.05.04. FAILURE OF FURNACE EXHAUST SYSTEM
8.05.05. CALCINER OVERPRESSURIZED

8.06 COCONVERSION PROCESS, COPRECAL (UO_2-PuO_2 PRODUCTION)—(I0806)

8.06.01 AMMONIUM NITRATE EXPLOSION IN CALCINER
8.06.02 HYDROGEN GAS EXPLOSION IN PROCESS AREA
8.06.03 PROCESS SOLUTION LEAK
8.06.04 CHEMICAL ADDITION ERROR
8.06.05 PRESSURIZATION OF CALCINER
8.06.06 CALCINER BREACHED FROM INTERNAL CORROSION
8.06.07 CALCINER BREACHED FROM IMPACT
8.06.08 EXCESSIVE PENETRATION OF CALCINE THROUGH THE CALCINER PRIMARY FILTER
3.06.09 FILTER SYSTEMS BREACHED
8.06.10 UNCONTROLLED REACTIONS
8.06.11 CALCINER NOZZLE PLUGGAGE

8.0 INCIDENTS FOR PLUTONIUM FINISHING (CONTINUED)

8.07. POWDER HANDLING AND PACKAGING ——— (I0807)

8.07.01. ESCAPE OF POWDER FROM CONTAINMENT
8.07.02. AIRBORNE ACTIVITY IN OPERATING AREA
8.07.03. VENTILATION AIR REVERSAL
8.07.04. LOADOUT INTO WRONG CONTAINER

8.08. LIQUID RECYCLE AND SCRAP RECOVERY ——— (I0808)

8.08.01. POWDER SPILL IN OPERATING AREA
8.08.02. COIL LEAK IN DISSOLVER

8.09. POWDER RECEIPT AND STORAGE ——— (I0809)

8.09.01. AIRBORNE ACTIVITY IN OPERATING AREA
8.09.02. VENTILATION AIR REVERSAL

8.10. FLUORINATION ——— (I0810)

8.10.01. FLUORINE RELEASE
8.10.02. HOLE BURNED IN FLUORINATOR VESSEL
8.10.03. FLUORINATOR OVERPRESSURIZATION
8.10.04. HIGH HF CONCENTRATION IN FLUORINE SUPPLY

8.11. REDUCTION ——— (I0811)

8.11.01. FIRE IN REDUCTION CABINET
8.11.02. EXPLOSION IN REDUCTION VESSEL
8.11.03. FURNACE FAILURE
8.11.04. BROKEN CRUCIBLE

8.12. METAL HANDLING AND PACKAGING ——— (I0812)

8.12.01. AIRBORNE ACTIVITY RELEASE
8.12.02. CONSTANT AIR MONITOR FAILURE
8.12.03. LOADOUT INTO WRONG CONTAINER

8.13. SCRAP RECOVERY ——— (I0813)

8.13.01. HYDROGEN EXPLOSION IN DISSOLVER
8.13.02. UNCONTROLLED CHEMICAL REACTION IN DISSOLVER
8.13.03. HIGH NEUTRON RADIATION
8.13.04. LOSS OF CONDENSER COOLING CAPACITY
8.13.05. TRANSFER ERROR
8.13.06. VESSEL OVERFLOW
8.13.07. COIL LEAK IN DISSOLVER
8.13.08. REDUCED CRITICALITY SAFETY MARGIN
8.13.09. LEAKAGE TO CABINET
8.13.10. FAILURE OF SAMPLER ASSEMBLY
8.13.11. FILTRATION WITHOUT A FILTER BOAT
8.13.12. HIGH TEMPERATURE IN DISSOLVER
8.13.13. UNCONTROLLED REACTION BETWEEN NITRIC ACID AND ANION EXCHANGE RESIN
8.13.14. ION EXCHANGE RESIN FIRE
8.13.15. ROOM CONTAMINATION DURING WASTE REMOVAL
8.13.16. TANK EXPLOSION

8.0 INCIDENTS FOR PLUTONIUM FINISHING (CONTINUED)

8.14. WASTE HANDLING ——— (IOS14)

8.14.01. FIRE IN WASTE HANDLING AREA

8.15. OFF-GAS TREATMENT ——— (IOS15)

8.15.01. FAILURE OF EXHAUST BLOWER
8.15.02. LOSS OF HEADER VACUUM
8.15.03. FISSILES IN VESSEL VENT HEADER
8.15.04. AIRBORNE ACTIVITY RELEASE FROM SCRUBBER
8.15.05. MASSIVE LEAK INTO VESSEL VENT HEADER
8.15.06. CANYON EXHAUST FAN FAILURE WHILE B-LINE FANS OPERATE
8.15.07. FAILURE OF GLOVE BOX EXHAUSTERS
8.15.08. DAMPER FAILURE
8.15.09. AIRBORNE ACTIVITY DURING FILTER REPLACEMENT

9.0 REFERENCES