Savannah River Site Hazard Analysis Generic Initiator Database

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DOE Contract No. DE-AC09-89SR18035

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WSRC-RP-95-915

Rev. 0

Savannah River Site
Hazard Analysis Generic Initiator Data Base (U)

October 1995

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SAVANNAH RIVER SITE

PREPARED FOR THE U.S. DEPARTMENT OF ENERGY UNDER CONTRACT NO. DE-AC09-89SR18035

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WSRC-RP-95-915

Rev. 0

Key Words: Frequency
 PHA
 Hazard Assessment
 HAD
 Bounding

Retention **Permanent**

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Issued: October 3, 1995

DOCUMENT: WSRC-RP-95-915, REV. 0

TITLE: SAVANNAH RIVER SITE HAZARDS ANALYSIS GENERIC
INITIATOR DATA BASE (U)

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1.0 INTRODUCTION

Improved efficiency is a goal continually sought by most dedicated analysts. This has become more important as budgets have shrunk. An effort was made to examine the safety documentation process and determine areas where a change in the process could result in significant cost reductions. As a part of this Safety Documentation Integrated Work Process Task (Ref. 1), several cost saving initiatives were identified. This report addresses the cost saving initiative related to generic frequencies for hazards analyses.

2.0 SUMMARY

A set of "generic" frequencies for various common accidents within the Savannah River Site has been developed. These values provide a conservative or maximum frequency for each accident. This allows the use of the generic frequencies as a "go-no go" test. If the use of the generic frequency in the hazard analysis produces an acceptable result, no further frequency analysis is needed. This will reduce cost by minimizing the number of accidents which will require detailed frequency analysis.

This set of frequencies is being published as an official Westinghouse Savannah River Company (WSRC) report to provide a referenceable basis for assigning initiating frequencies in the hazards analyses.

3.0 BACKGROUND

The initial task involved identification of the types of accidents which lend themselves to generic frequencies. Care must be used when applying data to be certain that the conditions for which the data was collected is conservative for the application under consideration. For this reason, a team was selected which consisted of two individuals familiar with the hazards analyses performed at the Savannah River Site (SRS) and two who were well versed in the interpretation and application of data. This mix allowed for selection of accidents typically addressed as a part of a hazards analysis and at the same time ensured that the frequencies would be of a conservative, maximum, and bounding nature.

In addition to accidents identified by the members of the team, a number of other sources were examined. The documents used included non-reactor Safety Analysis reports, the O & M Methodology Manual, the Hazards Analysis Checklist, the reactor probabilistic safety analysis, and the Unreviewed Safety Question Checklist for Accidents.

The list was then examined for applicability to hazards analysis. Some of the items were stated too broadly to obtain a frequency for the event. In these cases, an attempt was made to determine what initiator(s) could be identified as associated with the broad category and provide its frequency(ies). Another problem encountered was a lack of data. Some potential initiators did not have sufficient data to allow determination of the initiator frequency. These initiators, if

the consequences are severe enough, will require more detailed analysis to determine their frequency.

4.0 RESULTS

Table 1 is a list of the identified generic hazard analysis frequencies. Each frequency has a reference and, as appropriate, comments associated with it (table references follow the table). The comments are intended to provide the user with some indication of the derivation of the frequency and, therefore, its applicability to the situation under consideration. For example, the "Red Oil" frequency is listed as incredible for F-Canyon given its controls. It would not be appropriate to assume all "Red Oil" reactions are incredible unless controls similar to those in F-Canyon have been imposed. If more detail on the derivation of the frequency is desired, the reference may be consulted. It was intended that all frequencies be provided on a per hour basis. However, several initiators did not lend themselves well to the per hour unit. Sometimes a probability per demand, or accidents per mile was a far more useful unit. Therefore, the user is cautioned to examine each entry carefully to be certain that an appropriate application of the number is being made. Items for which data was not available at this time were labeled with "TBD" meaning To Be Determined. These items will be addressed in a future revision of this document.

5.0 CONCLUSIONS

The benefits from this effort will come in three areas. The frequencies assigned during the hazards analysis process will be more defensible, some hazards analysis effort will be saved, and some accident analysis effort will be eliminated due to the accident being binned out at the hazards analysis level. It is estimated that approximately 5 hazards analyses will be performed per year. The hazards analysis time will be reduced by about 24 man hours per analysis or 3 man-weeks per year. The screening process will now eliminate about 1 more accident than it would have previously. The entire accident analysis cycle requires 4 man-weeks. Thus, there will be an accident analysis savings of 20 man-weeks. The total savings will be 23 man-weeks or about 0.5 Full Time Equivalents.

6.0 REFERENCES

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7.0 TABLES

Table 1 Hazard Analysis Generic Initiator Frequencies

Initiator	Category	Comment	Max. Freq.	Units	Ref. No.
Air Pollution	Air Stagnation	Site Meteorology	2	/year	1
Airplane	Crash	For Onsite Area of 120 acres (0.19mi ²)	<2E-7	/year	2
Bearings	All	bearings, Ball, Heavy Duty	2E-5	/hour	3
Belts	All	Belts, Drive	4E-5	/hour	3
Truck	Haz. Material Movement Accident	From Site Transportation SAR	6E-06	accidents /mile	4
Cell Cover	Collapse	See Drop, Human Error	-	-	-
Charge/Discharge	Errors, Misloading	TBD	-	-	-
Chemical	Uncontrolled Chemical Reactions	F-Canyon SAR. Total	2	/year	5
	Red Oil	Based on F Canyon Operations with SCI's	<1E-6	/year	6, 7, 8
Chlorine	All	See Gases	-	-	-
Coil and Tube	Leak	F-Canyon	1	/year	5
	Rupture	PRA for USF	8E-3	/yr/coil	9
Cold	Ice, Snow, Wind, etc.	See Specific Category	-	-	-
Collapse	Building or Wall (Non-Seismic)	TBD	-	-	-
Combustible	Combustible Material	See Fire	-	-	-

Table 1 Hazard Analysis Generic Initiator Frequencies (Continued)

Initiator	Category	Comment	Max. Freq.	Units	Ref. No.
Common Cause	General	Use Beta Factor of 0.1. F stands for general frequency of initiator.	$F \times 0.1$	Freq.	10
Confinement	Coil and Tube	See Coil, Heat Exchangers	-	-	-
	Filters	See Filter	-	-	-
	Fuel Leakage	See Pipe, Tank, etc.	-	-	-
	Gasket/Seal	See Leak	-	-	-
	Pipe	See Pipe	-	-	-
	Shipping Container	See Shipping Container	-	-	-
	Valve	See Valve	-	-	-
	Vessel	See Vessel	-	-	-
	Pipe Break	See Pipe	-	-	-
	Piping Error	See Human Error	-	-	-
	Pluggage	See Pluggage	-	-	-
	Premature or Excessive Transfers	See Human Error	-	-	-
	Siphoning	See Siphoning	-	-	-
	Suckback	See Suckback	-	-	-
	Valving Error	See Human Error	-	-	-
	Vessel	See Vessel	-	-	-
Control circuit	All	See Electrical	-	-	-
Corrosion	General	TBD	-	-	-

Table 1 Hazard Analysis Generic Initiator Frequencies (Continued)

Initiator	Category	Comment	Max. Freq.	Units	Ref. No.
Crane	Drop	See Drop	-	-	-
Criticality	All	Situationally dependent, but with double contingencies present.	<1E-2	/year	Estimate
Dams	All	UCRL-15910	1E-4	/year	11
Debris	All	See Human Error	-	-	-
Diesel	Non-Electrical	Site Generic. Fan	5E-3	/hr	12
Distributed Control System	All	See Electrical	-	-	-
Drop	Cranes, Hoists, forklifts, etc.	TBD	-	-	-
	Fuel Bundle	TBD	-	-	-
	Human Error	See Human Error	-	-	-
Earthquake	PC0	Not Applicable	-	-	13
	PC1, 0.1g		2E-3	/year	13
	PC2, 0.13g		1E-3	/year	13
	PC3, 0.18g		5E-4	/year	13
	PC4, 0.32g		1E-3	/year	13
Electrical	Automatic Transfer Switches	Spurious Transfer	3E-2	/year	14
	Battery, Liquid	Reactor PRA work	0.1	/year	15
	Battery, Solid	Reactor PRA work	0.1	/year	15

Table 1 Hazard Analysis Generic Initiator Frequencies (Continued)

Initiator	Category	Comment	Max. Frequency	Units	Ref. No.
Electrical (Continued)	Breaker: Spurious Operation	Reactor PRA work	5E-3	/year	15
	Bus	Reactor PRA work	2E-2	/year	15
	Cable Runs	Cables, 1 to 33 kv	4E-6	/hour/km	3
	Control Circuit	See Distributed Control System	-	-	-
	Diesel with Generator	K-Reactor PRA	20	/year	10
	Distributed Control System	OREDA	1	/year	16
	Fuse	Site Generic	1E-7	/hour	12
	Heaters		1E-5	/hour	12
	Hot Plates	See Heater	-	-	-
	Interlock	Page 608	3E-7	/hour	17
	Lightning: Damaging	Damages Safety Equipment, Reactor PRA work.	0.2	/yr/ facility	15
	Lightning: General	Site Climatology. 4 in summer	6	/yr	1
	Locomotive Engine Wreck	See Train	-	-	-
	Motor	See Motor	-	-	-
	Power	See Power Loss	-	-	-
	Power Supply	Page 333	1E-6	/hour	17
	Pumps	See Pump	-	-	-

Table 1 Hazard Analysis Generic Initiator Frequencies (Continued)

Initiator	Category	Comment	Max Freq	Units	Ref No
Electrical (Continued)	Relays	Reactor PRA work.	5E-2	/year	15
	Service Outlets	TBD	-	-	-
	Short Phase to Phase (Hot Shorts)	One Foot Long Pair. Reactor PRA work.	5E-8	/yr/pair	18
	Short to Ground	Reactor PRA work.	1E-7	/yr/foot	18
	Static Electricity	TBD	-	-	-
	Switchgear	See Automatic Transfer Switch	-	-	-
	Thermocouples	Reactor PRA work.	5E-2	/year	15
	Transformers: All Failure Mode	Site Generic	1E-6	/hour	12
	Transformers: Fires		8E-4	/year	19
	Transmission Lines	Page 741	2E-7	/cycle/ft	17
	Underground Wiring	Page 771	7E-9	/cycle/ft	17
	Welding (Electrical)	See Fire	-	-	-
Expansion Joint	Wiring	Page 757	4E-9	/cycle/ft	17
	Leak	K-Reactor PRA	3E-2	/year	10
	Catastrophic	Sec. 2.1.3, 95 Methodology Manual	3E-4	/year	20
Explosion	Chemical Reactions	See Chemical	-	-	-
	Pressure Release	See Pipe or Vessel	-	-	-
	Gases/Vapors	Based on Tritium Data	2	/year	21

Table 1 Hazard Analysis Generic Initiator Frequencies (Continued)

Initiator	Category	Comment	Max. Frequency	Units	Ref. No.
Explosion (continued)	Metal: Powder	TBD	-	-	-
	Metal: Solid	TBD	-	-	-
	Red Oil or Nitration reactions	See Chemical: Red Oil	-	-	-
	Resin Column	See Uncontrolled Reactions	-	-	-
Fabrication Error	All	See Human Error	-	-	-
Falling	Collapse (building or wall collapse)	See Collapse or Earthquake	-	-	-
Fans	Spark	Sec. 2.1.6, 95 Methodology Manual	3E-2	/year	20
	Fail to Run	Site Generic. Motor Driven	3E-5	/hour	12
Filter	Emergency Water Cooling: Plug	Site Generic.	3E-6	/hour	12
	Emergency Water Cooling: Catastrophic	Site Generic.	5E-7	/hour	12
	HEPA	ITP Purge System	1E-2	/year	22
	Liquid	TBD	-	-	-
	Sand	Penetration Factor. Always Available	5E-3	Fraction	23
Fire	Process Related	F-Canyon SAR	1E-6	/hour	5
	Forest	TBD	-	-	-
	Motor	See Motor	-	-	-

Table 1 Hazard Analysis Generic Initiator Frequencies (Continued)

Initiator	Category	Comment	Max. freq.	Units	Ref. No.
Fissile Material	All	See Criticality	-	-	-
Flammables	All	See Fire	-	-	-
Flood	All	See Rain or Dam	-	-	-
Forklift	Drop	See Drop	-	-	-
	Wreck	See Human Error	-	-	-
Freezing	All	See Ice	-	-	-
Friction	All	See Valve, Pump, Fire,...	-	-	-
Fuel	Bad Diesel/Gasoline	K-Reactor PRA.	4E-2	/year	10
Gases	Fire	See Fire	-	-	-
	Release:Tritium	Based on Tritium Facility	4	events/ yr	21
	Release:Chlorine	Site Data	2E-4	/year/are a	24
	Explosion	See Explosion	-	-	-
Gear	General	Gear, Helical	1E-6	/hour	3
Hail/Sleet	All	Site Meteorology	0.5	/year	1
Halon	All	See Gases:Release	-	-	-
Heat Exchanger	Leak:Internal (several gpm)	95 Methodology Manual	2E-2	/year	20
	Leak:External	See Pipe, Vessel	-	-	-
	All Other (Plug,etc.)	See Filter, EWC:Plug	-	-	-
Helicopter	Crash:Offsite	See Airplane	-	-	-

Table 1 Hazard Analysis Generic Initiator Frequencies (Continued)

Initiator	Category	Comment	Max Freq	Units	Ref No
Helicopter Crash	Crash:Onsite	General	.5	/year	25
	Crash:Onsite into Building	Based on DWPF Location Relative to B Area	1E-10	/ft ² of Effective Target Area	26
Hoists	Drop	See Drop	-	-	-
Hot Shorts	Electrical	See Electrical:Phase to Phase	-	-	-
Human Error	High	Based on Supervisor Verification	.5	/Demand	27
	Moderate	Based on Supervisor Verification	.3	/Demand	27
	Low	Based on Supervisor Verification	.1	/Demand	27
	Overflow		5E-5	/tank-hr	27
Hurricane	All	Site Meteorology. Within State. (Once every 8 years)	0.1	/year	1
Ice	Accumulation on Surfaces	Site Climatology	0.5	/year	1
	0.5 in accumulation	Site Climatology	4E-2	/year	1
Ignition	Gases/Vapor, Liquids	See Fire	-	-	-
Interlock	All	See Electrical	-	-	-
Leak	All	See Pipe, Vessel,...	-	-	-
Lifts	Drop	See Drop	-	-	-
Lightning	All	See Electrical	-	-	-

Table 1 Hazard Analysis Generic Initiator Frequencies (Continued)

Initiator	Category	Comment	Max. Freq.	Units	Ref. No.
Line Breaks	Pipe	See Pipe	-	-	-
Meteorite	All		1E-9	/year	28
Missile	Compressed Gas	TBD	-	-	-
	Turbine	TBD	-	-	-
Missile (continued)	Tornado	See Tornado	-	-	-
Motion	Vehicles/forklifts and trucks	See Vehicle, Drop, etc.	-	-	-
Motors	Fire	TBD	-	-	-
	Fails to Run	Site Generic. DC.	1E-5	/hour	12
Natural Phenomena	Natural Phenomena	See Earthquake, Tornado, ...	-	-	-
Nuclear Criticality	All	See Criticality	-	-	-
Overflow	All	See Human Error	-	-	-
Overpressurization	Human	See Human Error	-	-	-
Pipe	Catastrophic	95 Methodology Manual	1E-6	/ft/year	20
	Leak Size	95 Methodology Manual	2E-5	/ft/year	20
	Pipe Size	95 Methodology Manual	2E-5	/ft/year	20
	Pluggage	Reactor PRA work.	1E-6	/year	29
Power Loss	Normal & Emergency/480V	TBD	-	-	-
	Normal/480V	TBD	-	-	-

Table 1 Hazard Analysis Generic Initiator Frequencies (Continued)

Initiator	Category	Comment	Max Freq	Units	Ref No
Power Loss (continued)	Normal/12.8KV	TBD	-	-	-
	Normal/Area 115KV	TBD	-	-	-
Pressure	Gas Bottles	See Missile, Gases:Release	-	-	-
	Gas Receivers/Reservoir	See Overpressurization	-	-	-
	Pressure vessels	See Pipes, Vessel	-	-	-
	Steam headers and Lines	See Steam Tube	-	-	-
Pump	Fails to Run	Site Generic. Motor or Turbine Driven.	1E-4	/hour	12
Pyrophoric Material	All	See Fire	-	-	-
Radiation, Ionizing	All	See Criticality	-	-	-
Radiolysis	All	See Explosion or Fire	-	-	-
Rain	High (> 5in/24 hrs)	Site Climatology	0.2	/year	1
	Moderate(> 3 in/24 hrs).	Site Climatology	1	/yr	
Red Oil	All	See Chemical	-	-	-
Rigging	Drop	See Drop	-	-	-
Roof or Wall Collapse	All	See Earthquake or Collapse	-	-	-
Rupture	All	See Pipe, Vessel,...	-	-	-

Table 1 Hazard Analysis Generic Initiator Frequencies (Continued)

Initiator	Category	Comment	Max Freq	Units	Ref No
Rust	All	See Corrosion	-	-	-
Shorts to Ground	All	See Electrical	-	-	-
Siphoning	Liquid	F-Canyon SAR	2E-5	/hour	5
Sleet/Hail	All	See Hail/Sleet	-	-	-
Snow	> 12 inches	Max 13 inches in 1973	5E-2	/year	1
	1 inch or more	Site Climatology	0.2	/year	1
	Time Snow Remains on Ground	Site Climatology, Rarely Exceeds	3	days	1
Spill	Liquid	F-Canyon SAR. Leak, Overflow	7E-3	/hour	5
Spontaneous Combustion	All	See Fire	-	-	-
Stack failure	All	See Collapse	-	-	-
Steam Tube	Leak	See Coil & Tube Leak	-	-	-
	Catastrophic Failure	See Coil & Tube Rupture	-	-	-
Straight wind	All	See Tornado	-	-	-
Structural	Collapse	See Collapse	-	-	-
Suckback	All	See Siphoning	-	-	-
Tank	All	See Vessel	-	-	-
Temperature	Ambient:High	Site Climatology. >100°F	1	/year	1
	Ambient:Low	See Ice	-	-	-
Thermal	All	See Fire	-	-	-

Table 1 Hazard Analysis Generic Initiator Frequencies (Continued)

Initiator	Category	Comment	Max. Freq.	Units	Ref. No.
Thunderstorms	Average	Site Climatology. Most June, July & August	5	/month	1
Tornado	PC0	Not Applicable	-	-	13
	PC1,	Not Applicable	-	-	13
	PC2	Not Applicable	-	-	13
	PC3	137 mph, 40psf @ 20 psf/sec	2E-5	/year	13
	PC4	192mph, 125 psf @ 50 psf/sec	2E-6	/year	13
	>155 mph		2E-5	/year	30
Train	Derail	Exceeding 60 ft. from track	<1E-6	/yr	31
	Haz. Material Movement Accident	From Site Transportation SAR	1E-5	accidents / mile	4
Transfer Error	All	See Human Error	-	-	-
Trench Cover	All	See Drop, Human Error	-	-	-
Tripping, Slipping	All	See Human Error	-	-	-
Tube and Coil	Leak	See Coil & Tube Leak	-	-	-
Turbines	Missiles	See Missile	-	-	-
Uncontrolled Chemical Reactions	All	See Chemical	-	-	-

Table 1 Hazard Analysis Generic Initiator Frequencies (Continued)

Initiator	Category	Comment	Max. Freq.	Units	Ref. No.
Vehicle	Airplane	See Airplane	-	-	-
	Helicopter	See Helicopter	-	-	-
	Train	See Train	-	-	-
	Truck/Car	See Car/Truck	-	-	-
Vessel	Leak	Site Generic. Unpressurized	1E-7	/hour	12
	Catastrophic	Site Generic. Unpressurized	5E-9	/hour	12
Vibration	Mechanical	See Motor, Pipe, Valve,...	-	-	-
Volcanoes	All		<1E-6	/year	32
Water	All	See Dam, Rain, Leaks, Spills,...	-	-	-
Weather	All	See Type of Weather	-	-	-
Wind	High, Straight	See Tornado	-	-	-
	Hurricane	See Hurricane	-	-	-
	Tornado	See Tornado	-	-	-

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