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**DETERMINATION OF FREQUENCIES OF TRITIUM RELEASES AND
FIRE RELATED INCIDENTS FOR TRITIUM FACILITIES SAR (U)**

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DETERMINATION OF FREQUENCIES OF RELEASES AND FIRE RELATED INCIDENTS FOR TRITIUM FACILITY SAR (U)

INTRODUCTION

At the request of the Risk Analysis Group (RAG), and in support of the Tritium Facilities SAR, the Safety Information Management and Analysis group (SIMA) determined specific frequency values dealing with tritium releases and fire related incidents. All results summarized herein are based upon actual facility operating data from the Tritium Fault Tree Databank. The Descriptive Statistics function within Excel was utilized to compute initiator event frequencies from appropriate event data. All calculations have been technically reviewed to ensure that they are accurate mathematical representations of actual operating history as recorded in the databank.

SUMMARY

Results of the frequency analyses are summarized in Table 1.

Table 1. Summary of Frequency Analyses for the Tritium SAR

Text Description	Mean Frequency (per year)	Median Frequency (per year)	Standard Deviation (per year)
Fires in 232-H	0.37116708	0.50137363	0.31578665
Fires in 233-H	N/A	N/A	N/A
Fires in 234-H	0.63278172	0.97986577	0.54675302
Potential Deflagration or Explosion in 232-H	1.908853194	30.41666667	0.964065504
Potential Deflagration or Explosion in 233-H	N/A	N/A	N/A
Potential Deflagration or Explosion in 234-H	0.811368688	2.991803279	0.459152833
Fire Alarm Failure in 232-H, 233-H, and 234-H	N/A	N/A	N/A
Sprinkler Failure in 232-H, 233-H, and 234-H	N/A	N/A	N/A
Operations Errors Resulting in Release	0.981094884	1.590413943	0.773425945
Maintenance Errors Resulting in Release	1.538693165	3.613861386	1.03890995
Component Failure Resulting in Release	1.020889782	2.317460317	0.824356811
Tritiated Water Spills	0.314655172	0.506241331	0.350098577

REQUIREMENTS

The customer, RAG, made a request to SIMA for frequencies applicable to the Tritium Facilities SAR. SIMA was asked to provide RAG with frequency of failure and unavailability for 232-H, 233-H, and 234-H sprinkler system and fire alarm systems. In addition, SIMA was asked to produce frequencies associated with fires and tritium releases at the Tritium Facilities. For details of requirements consult calculation no. S-CLC-G-00078, Determination of Frequencies of Tritium Releases and Fire Related Incidents for Tritium Facilities SAR.

METHODOLOGY

The SRS Fault Tree Databanks are a compilation of events and occurrences at SRS from 1954 to the present. SIMA maintains Fault Tree Databanks for 200-Area, 300-Area, Tritium, Waste Management, and SRTC. The SRS Fault Tree Databanks were used to recall historical data for all requested frequency/unavailability values. The Tritium Databank was selected as the source of data since more than 13,000 historical events have been collected during facility operations.

The following sorts (i.e., data searches) were run on the Tritium Databank. These sorts were run using the code structure published most recently, SRT-TLM-93-0011, "Update of Tritium Area Fault Tree Databank - Unit Operations and Building Codes (U)".

Sort Descriptions

- 1) Descriptive Text
Any kind of fire in Building 232-H
Fire alarm failure in 232-H
Sprinkler failure in 232-H

Sort Criteria
Facility = "B"
Equipment Codes = "048 or 049 or 050 or 056 or 057 or 169 or 287 or 297 or 275"
- 2) Descriptive Text
Any kind of fire in Building 233-H
Fire alarm failure in 233-H
Sprinkler failure in 233-H

Sort Criteria
Facility = "D"
Equipment Codes = "048 or 049 or 050 or 056 or 057 or 169 or 287 or 297 or 275"

- 3) Descriptive Text
Any kind of fire in Building 234-H
Fire alarm failure in 234-H
Sprinkler failure in 234-H

Sort Criteria

Facility = "A"

Equipment Codes = "048 or 049 or 050 or 056 or 057 or 169 or 287 or 297 or 275"

- 4) Descriptive Text
All releases from operations error in 232-H, 233-H, and 234-H
All releases from maintenance error in 232-H, 233-H, and 234-H
All releases from component failure in 232-H, 233-H, and 234-H

Due to restrictions associated with the Tritium data sorts, this request was completed with three sorts.

Sort Criteria

Facility = "A or B or D"

Equipment Codes = "(062 or 126 or 103 or 195 or 198) & 081 & 188"

Sort Criteria

Facility = "A or B or D"

Equipment Codes = "(062 or 126 or 103 or 195 or 198) & 081 & 189"

Sort Criteria

Facility = "A, or B, or D"

Equipment Codes = "(062 or 126 or 103 or 195 or 198) & 081 & 190"

- 5) Descriptive Text
All tritiated water spills in 232-H, 233-H, and 234-H

Due to restrictions associated with the Tritium data sorts, this request was completed with two sorts.

Sort Criteria

Facility = "A or B or D"

Equipment Codes = "175 & (186 or 187 or 188 or 189 or 190)"

Sort Criteria

Facility = "A or B or D"

Equipment Codes = "166 & (186 or 187 or 188 or 189 or 190)"

- 6) Descriptive Text
Any kind of process deflagration or explosion in 232-H

Sort Criteria

Facility = "B"

Equipment Codes = "(044 or 054 or 057 or 169 or 191)"

- 7) Descriptive Text
Any kind of process deflagration or explosion in 233-H

Sort Criteria
Facility = "D"
Equipment Codes = "(044 or 054 or 057 or 169 or 191)"

- 8) Descriptive Text
Any kind of process deflagration or explosion in 234-H

Sort Criteria
Facility = "A"
Equipment Codes = "(044 or 054 or 057 or 169 or 191)"

There are several occurrences in the databanks where the data are presented in monthly reports. These reporting mechanisms frequently do not record the actual event date; they simply report the month of the occurrence. In these cases, it was assumed that the event occurred on the first of the month in which it was reported.

There are two instances in the data where several events are reported over a date range. Specific dates for each event are not recorded. In these two cases, the number of events were spread over the date range reported.

Another data source was identified for fire data. A sort was run on this data for comparison. Three events were identified to be additions to the Tritium Databank. These three events were included in the analyses.

Each entry from each data set was read to ensure applicability to the analysis. Duplicate and/or inappropriate entries were eliminated. A threshold of 1000 curies was established by the customer to eliminate retrieval of data with minimal significance associated with spills and releases. The engineering calculation associated with this work (Calculation S-CLC-G-00078, Determination of Frequencies of Tritium Releases and Fire Related Incidents for Tritium Facility SAR), contains additional details on the analyses, some of which are classified as Secret Weapons Data.

When the data sorts were run, no restrictions were placed on date range. However no data beyond July 1993 was present at the time of this analysis. The frequency per year was calculated for the range of data available for each sort. Once the subset of applicable events was compiled, the corresponding dates-of-occurrence were collected in a file for statistical analysis.

The Descriptive Statistics function of Excel was used to analyze the date-of-occurrence files and compute frequencies. This analysis produced values for mean, median, and standard deviation. Excel version 4.0 on the Macintosh was used in all analyses. Where data sets were limited (i.e., less than three events within the data set), frequencies were not calculated.

RESULTS

The following table gives results of the analysis. Mean, median, and standard deviation frequencies are reported for all applicable cases.

Table 4. Results of Analysis

Text Description	Mean Frequency (per year)	Median Frequency (per year)	Standard Deviation (per year)
Fires in 232-H	0.37116708	0.50137363	0.31578665
Fires in 233-H	N/A	N/A	N/A
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Sprinkler Failure in 232-H, 233-H, and 234-H	N/A	N/A	N/A
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Component Failure Resulting in Release	1.020889782	2.317460317	0.824356811
Trinitated Water Spills	0.314655172	0.506241331	0.350098577

In addition to the frequencies, it was noted that the following initiators were associated with the 14 fires in 232-H:

of fires initiated by engines (i.e., diesel generators, etc.).....1
 # of fires initiated by maintenance/construction.....7
 # of fires initiated by electrical components.....5
 # of fires initiated by operations/process.....1

Four of the fourteen fires in 232-H resulted in successful manual suppression.

It was noted that the following initiators were associated with the 23 fires in 234-H:

of fires initiated by engines (i.e., diesel generators, etc.).....2
 # of fires initiated by maintenance/construction.....8
 # of fires initiated by electrical components.....6
 # of fires initiated by operations/process.....6

Of the 23 fires in 234-H, three resulted in successful manual suppression and one resulted in a failed attempt at manual suppression.

The reported fire alarm system failure does not take into account any procedural requirements for "fire-watch" personnel. These individuals may compensate for failure of the fire alarm system.

No data were recorded in the Tritium Fault Tree Databank for fire related events, fire alarm system, fire sprinkler system or process deflagration/explosion in 233-H.

Tritium releases were recorded and categorized as follows:

# of operations errors	1.0E+03 - 1.0E+04.....	22
# of operations errors	1.0E+04 - 1.0E+05.....	8
# of operations errors	> 1.0E+05.....	1
# of maintenance errors	1.0E+03 - 1.0E+04.....	41
# of maintenance errors	1.0E+04 - 1.0E+05.....	2
# of maintenance errors	> 1.0E+05.....	0
# of component failures	1.0E+03 - 1.0E+04.....	18
# of component failures	1.0E+04 - 1.0E+05.....	11
# of component failures	> 1.0E+05.....	4

CONCLUSIONS

Initiator event frequencies were developed for the Tritium Facilities SAR based upon Tritium facility operating experience. The Tritium Fault Tree Databank was the source for event data, and the Descriptive Statistics function within Excel was used to develop statistical data. Since the values presented herein were based on site specific operating experience, they represent the best possible probabilistic representation of expected system performance. All calculations and computer runs were independently reviewed, and all calculations were made in accordance with E7, Procedure 2.31.

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