A Study on Fire Ignition Frequency of UCN 3 by New Fire PSA

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1. Introduction

A fire ignition frequency of UCN 3 was calculated by using the new fire PSA method suggested in NUREG/CR 6850[1] and its supplement[2]. The results was finally verified and modified through the walkdown at UCN 3. In the paper, how the fire ignition frequency of UCN 3 was calculated and what is the result of walkdown are presented.

2. Methods and Results

2.1 Fire ignition frequency of UCN 3

Load list is used to screen out small capacity components. For an example, pumps and motors whose capacity are below 5 hp are screened out. Drawings are used to count the ignition sources such as electrical panel(LP), control panel(CP), load centers, switchgears, motor control centers (MCC), etc. For example, in Fig. 1, a battery charger (BC) (equip no: 0841EBC01E), and 12 MCCs (equip no: 0827EMC01E) can be found. These analyses are recorded in a form shown in Table 1 as a database (DB). The total number of rooms is 196, and transient ignition sources such as oil and cables, etc, as well as fixed ignition ones are managed in the ignition source DB.

If a room (a fire area) is selected and clicked in the table of the DB, the fire frequency due to the ignition sources in the room (the fire area) is calculated as shown in Fig. 2. If room '100-N02' is selected and clicked in Table 1, and then the fire frequency of the room due to the ignition sources (BC and MCC) is shown in Fig. 2.

In the ignition source DB, the following buildings or areas are excluded since the risk of the building is low; Fuel handling building, office building, maintenance shop, warehouse, etc.

2.2 Walkdown at UCN 3

Walkdown was done in the important buildings such as auxiliary building, turbine building, etc, where electrical equipment room, switchgear room, etc., locate. Through the walkdown, we can correct the miscount which was made in the analysis of drawings. The types of miscount are 'overcount', 'undercount', or 'omission' of the components. An omission example is the case where new components (e.g. time synchronization panels) were installed. All miscount occurred in Bin 15.1 (electrical cabinets) since all miscount was related to LPs and CPs. 53 LPs or CPs was corrected as 203, and thus 1089 electrical cabinets of Bin 15.1 was changed to 1239 electrical cabinets (14% changed). Meanwhile, for the HEAF by bus duct (Bin 16.1), the number of connection on the NSPB which was roughly estimated with one line diagram was corrected with a site engineer interview and a maintenance procedure.

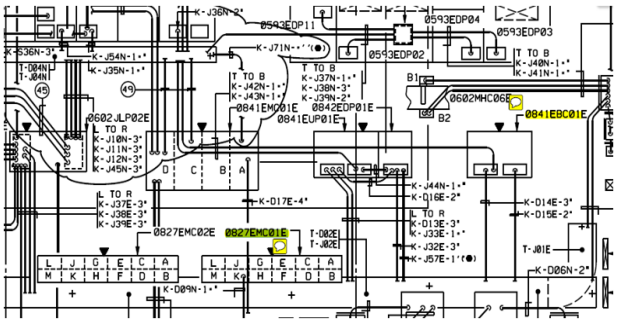

Fig. 1. Ignition sources can be found in a drawing

Table 1: Example of Fixed Ignition Source DB

BLDG	ID	Fire Area No.	Fire Area Name	Room No	Room Name	IGNITION SOURCE	Type	QTY	EQUIP NO.
AACDG	10	100-NDG	AAC DG AREA	100-N02	DG Control Room	CLASS 1E Battery Charger	BC	1	0841EBC01E
AACDG	15.1	100-NDG	AAC DG AREA	100-N02	DG Control Room	CLASS-1E 480V MCC	MCC	12	0827EMC01E

2.3 Results

The fire ignition source DB of UCN 3 was developed for 196 rooms, and the fire frequency due to the ignition sources can be shown, room by room. After walkdown of UCN 3, 14% electrical cabinets was modified.

3. Conclusions

The fire ignition frequency of UCN 3 reflecting the walkdown results was calculated, and the results were compared with the old methods. Generally, the fire ignition frequency based on the new method is the lowest one.

Acknowledgements

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REFERENCES

[1] EPRI/NRC-RES, "Fire PRA Methodology for Nuclear Power Facilities," NUREG/CR-6850, Nuclear Regulatory Commission, Washington, DC, (2005).

[2] EPRI/NRC-RES, "Fire Probabilistic Risk Assessment Methods Enhancements" NUREG/CR-6850 Supplement 1, Nuclear Regulatory Commission, Washington, DC, Sept 2010.

1. Description

FIRE AREA	100-NDG
FIRE Room No	100-N02

2. Calculation

NUREG/CR-6850 Method

ID	Location	Ignition Source	(A)	(B)	(A)/(B)	(FF)	(FISF)
10	Plant-Wide	Battery Chargers	1	31	3.23E-2	1.18E-3	3.8E-5
13	Plant-Wide	Dryers		3	0.00E+0	4.20E-4	
14	Plant-Wide	Electric Motors		69	0.00E+0	3.41E-3	
15.1	Plant-Wide	Electrical Cabinets-Non-HEAF	43	1075	4.00E-2	2.36E-2	9.4E-4

3. Result

NUREG/CR-6850 Method	Value
Fire Frequency for Plant Wide Ignition Sources=$F^{PW}_{T}=\sum F^{PW}_{IF}$ (Except Transient)	9.82E-4

Fig. 2. An example of fire frequency due to the fixed ignition sources at room '100-N02'

Table 2: An Example of Fixed Ignition Source DB

Fire Zones	Fire Zones Description	Equivalent Fire Area/Zone	Old Method	NUREG /CR-6850	NUREG/ CR-6850 Suppl.
...	...	...	...	...	...
144-A01	MCR	144-PACR	2.56E-3	3.48E-03	1.34E-03
100-A03A	Inverter room A	100-A03A	5.04E-04	1.09E-03	6.15E-4
000-TBB	Turbine BD	000-TBB	5.37E-2	6.05E-02	3.46E-2
100-A01B	Switchgear room B	100-A01B	5.78E-4	9.96E-04	7.08E-4
Total Fire Frequency of Fixed Ignition Sources			1.9E-01	1.74E-01	9.39E-02