Sensitivity Analysis via Modelling FLEX/MACST Equipment into a PSA Model

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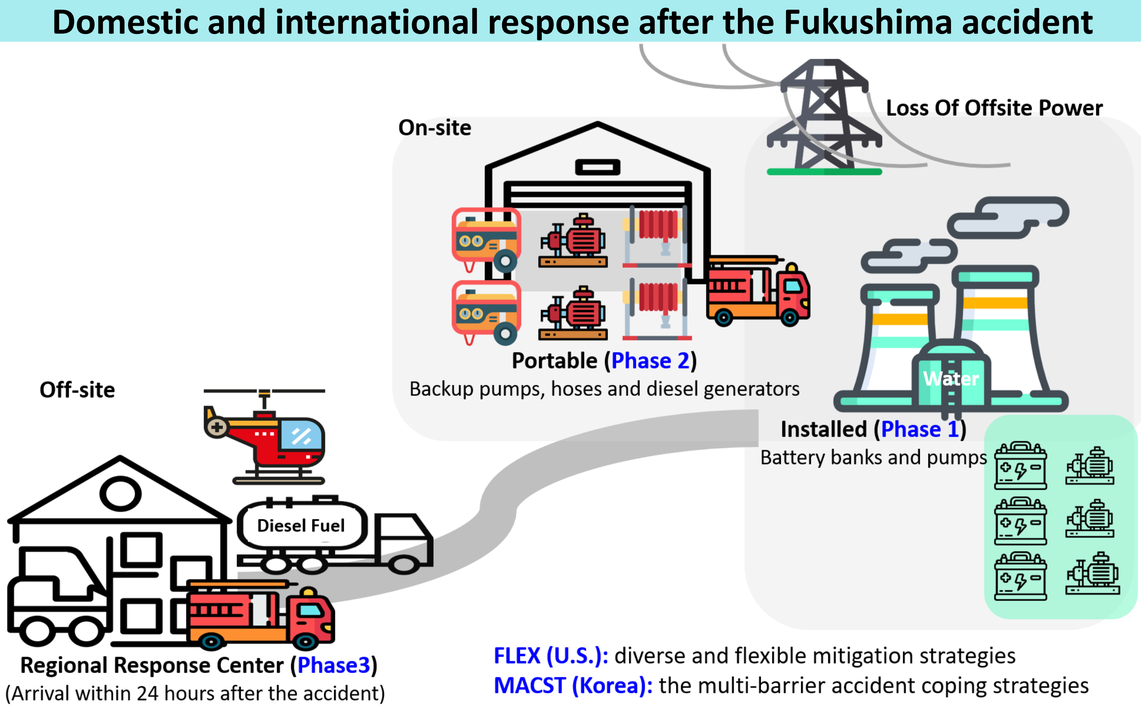
Introduction

Domestic and international response after the Fukushima accident



FLEX (U.S.): diverse and flexible mitigation strategies
MACST (Korea): the multi-barrier accident coping strategies

The nuclear safety act of Korea revised in 2016

- The licensee shall submit an accident management plan (AMP) which shall be capable of achieving the deterministic and probabilistic safety goals (i.e., CDF < 1.0x10-4/yr, LERF < 1.0x10-5/yr).

Challenges for reflecting FLEX/MACST into PSA model

- Lack of data for portable hardware reliability and human error probabilities for key operators actions needed to use portable FLEX/MACST equipment
- No explicit guideline on how to incorporate FLEX/MACST strategies and equipment into PSA models

Objective of this study

- To verify FLEX/MACST strategies' effectiveness with modeling the portable equipment into an existing PSA model

Considerations for modeling FLEX/MACST equipment

Portable generator (1MW, 480V)	• Target initiating event (IE): station black-out (SBO) -Reflecting a generator into AFTDP success & AAC fail & loss of off-site power (LOOP) fail scenario -Function: Supply emergency power to Battery Charger
Low pressure portable pump	• Target IE: total loss of component cooling water (TLOCCW) -Modelling a pump into SHR & MSHR FT model -Reflecting a pump into FT model of failure of AFW source transfer from AFWST to RWT (long-term) • Target IE: SBO-S,SBO-R -Modelling a pump into MSHR FT model -Reflecting a pump into FT model of failure of AFW source transfer from AFWST to RWT (long-term) • Target IE: steam generator tube rupture (SGTR) -Modelling a pump into RWST refill scenario
High pressure portable pump	• Target IE : TLOCCW - Modelling a pump into RCP seal loss of coolant accident (LOCA) scenario

Assumption of FLEX/MACST reliability data

- **Approach 1**
  - (Reliability of portable equipment)=(Reliability of permanently installed component)×(Adjustment factor)
    - Fixed equipment reliability data from NUREG/CR-6928 (2015)
    - Adjustment factor from PWROG-14003
- **Approach 2**
  - (Portable equipment in nuclear field)=(Portable equipment in military field) ×(Adjustment factor)
    - Adjustment factor from EPRI 3002003151 (2014)
- **Approach 3 (Our approach)**
  - Human error probability from IDHEAS-ECA(2020)

Critical Task	HEP Estimate
Connect and start diesel generator	**Low E-2** to Mid E-3

- Collection of weather conditions at the historical cases of nuclear power plants shutdown
- Suggestion of component reliability depending on weather condition
  - 0.1: Area expected to show confidence within the normal range
  - 0.5: Area where the probability of success is expected to be moderate
  - 1.0: Unable to guarantee (human and component) reliability if a certain value is exceeded

CDF changes with FLEX/MACST strategies

Conclusions

- This study revealed that the MACST strategy and equipment could reduce plants' CDF values significantly depending on an initiating event.
- More efforts are required to acquire reliability data for portable equipment and assure human reliability values for key operator actions needed to implement MACST strategies.

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References

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