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한국원자력학회 2021년 추계학술대회 2021년 10월 20~22일, 창원(온라인)

Korean Nuclear Society Autumn Meeting, Oct . 20-22, 2021

4가지 주요 원자력 사건에서 위반 오류와 대책 재검토
A Revisit Study on Violations and their Countermeasures to Four Major Nuclear Accidents

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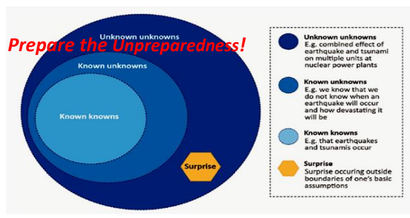
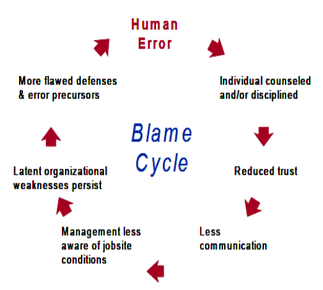
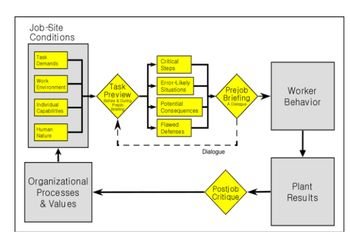
1. Introduction

- Safety of nuclear systems : born from best science, secured in advance variety of pre-designed functions.
- Experience of unexpected events and accidents : 4 major accidents used as common tasks in the global nuclear sector.
  - Learning from nuclear accident from the perspective of human error. (1992 Rasmussen, 2015 Lee).
  - Human error : strategic and effective perspectives in interpreting and learning safety experienced
  - Responsibility Controversy (HE & violation), requiring careful or pre-designed methodologies in practice.
  - In particular, human error interpreted as violations : frequent & sensitive to increased hyper-connectivity & vulnerability of
  - controversy over responsibility for violations and come up with more effective technical measures.
- Effective analysis method for violation errors – Revisit to human error in 4 major domestic and foreign cases.







2. Concept of Human Error 3.0

*** *Safety Culture Attribution? : A Road to Resolution or War***

- Triviality : self-evident to all Events negative or positive
- Convenient : Termination Criteria to Event Investigations
- Artificiality : to Countermeasures

➢ *Human Error 1.0~3.0* the main focus & countermeasures (2016, 2018, 2019 Lee).

- HE 1.0 : Machine Problem -> Human Solution : Time-and-Motion Study + E&T
- HE 2.0 : Human Problem -> Interface Solution : Interface Compatibility, MMIS Concept
- HE 3.0 : No(?) Defect/Fault -> Cooperative Solution : Intrinsic and Structural Limits, Countermeasures

➢ *Human Error 3.0*

- Non-faulty/Non-faulty normal accident: human resources and human resources
- The ultimate/infinite responsibility premise of a dangerous society: the common destiny of future safety
- Possibility of countermeasures independent of causes: Field safety based on practical reality
- Trust-based human factors safety: mutual trust-based discovery among stakeholders
- Infinite responsibility safety based on participation: Continuous expansion of safety value through active participation
- Safety of future-oriented creative measures: Focus on future measures at a new level

4 Major Nuclear Cases studied for Violation

- Former Soviet: Chernobyl nuclear accident (1986)
- Japan JCO: nuclear re-criticality accident (1999)
- Kor#1: Station Black Out and concealment (2012)
- Hanbit#1: power increase/delayed manual trip (2018)

**** Inherent HE Limits of Safety in Nuclear System***

- High reliability large system
- Complex interdisciplinary process
- Non-injury system-loss safety
- Segmented and out-of-the-loop system
- Tightly-coupled functional closed system

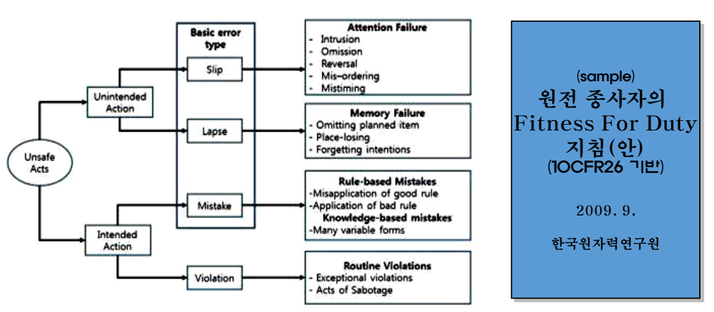
3. Revisit to Major Accident cases (by Human Error 3.0 & Violations)

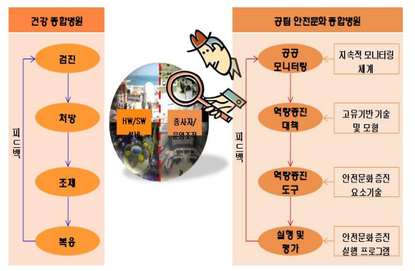
3.1 Fundamental characteristics of nuclear safety:

3.2 Overview of violations of human error incidents : Impact of Violations and CMs

3.3 Re-visit and Review of Human Error Cases

- Chernobyl : plan error with a flaw in the safety feature and culture ~ *always right as a cause. Triviality*
  - *Convenience of* main cause of safety culture unduly comprehensive
  - *Arbitrary-ness on countermeasures by virtue of the vagueness of safety culture*
- JCO : most typical permitted routine violations poorly managed over a long period .
  - safety management, as the violators not even aware of the possibility of human casualties.
  - Short after-MATH discussions not international still obscured by a comprehensive safety culture.
  - safety culture attribution phenomenon worsened in Japan's nuclear sector
  - no improvement in safety culture until cover-up of corruption in 2002 & 2011 Fukushima accident.
- Gori -1 : cover-up violations immediately after the Fukushima accident
  - lack of independence of the organization's authority and make-up, and poor safety decision-making
  - safety culture sharply highlighted, led to the emphasis on the management perspective as the cause of safety culture.
  - remained relatively distant, subject to uncertainty not only its substance but also its concrete intervention.
  - Although the evaluation and improvement of safety culture has been implemented from various perspectives through the Gori # 1 event, it is not clear whether the actual improvement has been made or not. Rather, has intensified due to confirmation bias in all subsequent domestic nuclear incidents.
- Hanbit - 1 : highly organized and constantly reinforced violations.
  - systematically insisting on unintended HE, relatively simple, it has been turned into a violation.
  - showed a new aspect OF Human error as it led to an interrogation for legal responsibilities rather than countermeasures
  - core of the countermeasures : CCTV surveillance functions

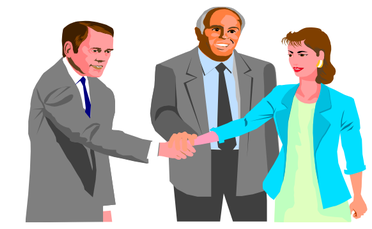


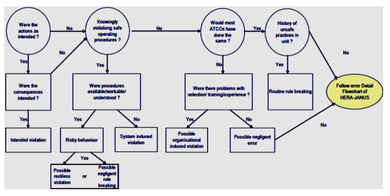


4. Conclusion and Discussions :

*** Common Findings from the Revisit to 4 Major Nuclear Cases**

1. Effectiveness of Responsibilities to violations is uncertain : the paradigm of *Human Error 3.0* or *Normal Accident* -> fundamental limitations the actual risk of accidents stems from the of the system itself. person involved caused by the fundamental limitation is only realized in a situation. (*In addition, individuals' pursuit of responsibility does not seem to help compensate/recovery for future past losses at all, and does not seem to have much meaning in improving safety. The justification for the culpability of violations as well as the effectiveness of the reprimand in terms of efficiency should be carefully considered.
2. Violations as a matter of Safety Culture: critical relationship, due to the excessive inclusiveness of safety culture terms, efforts to improve the actual violation problem are not clearly revealed in the countermeasures. Measures for violations derived by over-expanding representation (or over-expanding and generalization errors) can be hindered in tracking whether effective learning has been achieved from the problem of violations actually revealed.
3. Practical Measures to address the burden of violations for workers : employee duties on the basis of the role defined by the contractual & current law requires the state to hold the individual responsible for so many job violations and stipulates punishment. This is excessive beyond the principles of the contracting party, as it goes beyond the job requirements required by the operator or at least through the operator. (*Legal demands for job requirements that are not within the scope of social and ordinary obligations beyond the obligations of nuclear operators and the way of punishment for violations are feared to have a negative ripple effect.(types of violations ~ avoidance, neglect, responsibility disputes, and arbitrary interpretation, irresponsibility structure)
4. a New Approach to violations urgent : The post-improvement-oriented approach based on individual factors, which has developed from a human error 2.0 perspective, was an important point of view to achieve many innovative high reliability systems as well as nuclear systems. However, it seems that effective measures for the future cannot be accessed only from the perspective of human error 2.0 and MMIS that specifies and improves factors.





Types and Factors of HE

- Expanded widely
- Become crucial &Uncertain
- Demanding fore Safety Concern
- Practical Learning over SC
- Integrated Safety

*** New Concept of Human Error 3,0** to overcome current approaches : key measures for re-analysis ~ tracking & verification of the effectiveness of CMs, and the complementary introduction of Safety-II and Resilience perspectives centered on the ability to maintain safety beyond fault/failure-driven limits.

- How to Treat Violations : Safety Culture? (Personal/Org.) Responsibility? => Remedial Countermeasures
- Public opinion-based distrust of the parties involved -> entire domestic nuclear system continued to rise negative controversy

Human Error 3.0 & Violations

- CM before Causes Practically
- Technical over Cultural
- Proactive by Retrospections
- Technical Vulnerability
- Minimized the culpability

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- **ACKNOWLEDGMENT** This paper is supported by the Nuclear Safety Research Program grant funded by Nuclear Security and Safety Commission (NSSC) and KOFONS (*No. 2003010*).