Maintenance Effectiveness MOnitor System (MEMOS)

Pi-Lin Hsu, Shang-Tzu Ho
PRA Group
Institute of Nuclear Energy Research
Presented by: Pi-Lin Hsu

ISO 9001
BSMI

PSAM 9

Kwoloon Shangri-la Hotel, Hong Kong, China

23 May 2008

Outline

- Introduction
- System Design and User Interface
- Conclusion

Introduction

- The MEMOS is a computer-software which is based on USNRC 10CFR 50.65, “Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants”.
- The responsibility of the nuclear utility is to keep equipment in a reliable condition and perform intended safety functions when needed.
- By implementing Maintenance Rule, the U.S. plant’s operation performance indicators and productivity of electricity had made a big progress, and also shortened refueling outage as a result of safer on-line maintenances.

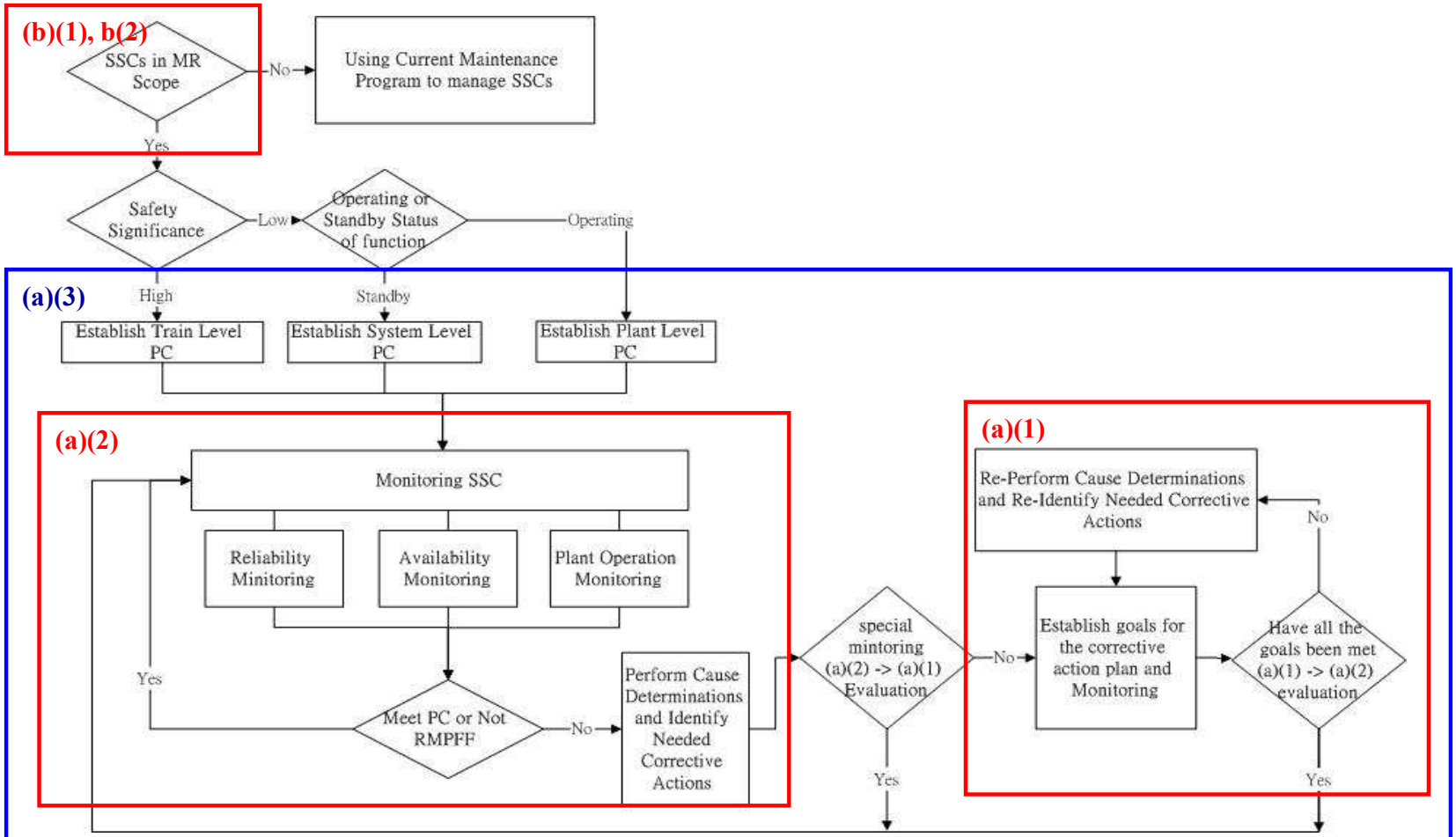
Introduction (Cont.)

- In View of the fruitful outcomes, the Taiwan Power Company has announced their policy to implement the MR from the beginning of 2008, under the objective of future rolling on-line maintenance.
- In order to achieve the goal, the TPC initiated a corporate project with Institute of Nuclear Energy Research to setup MR for three plants in Taiwan.
- The MEMOS has been developed by the INER since 2006.
  - Stand alone version
  - Web-based version

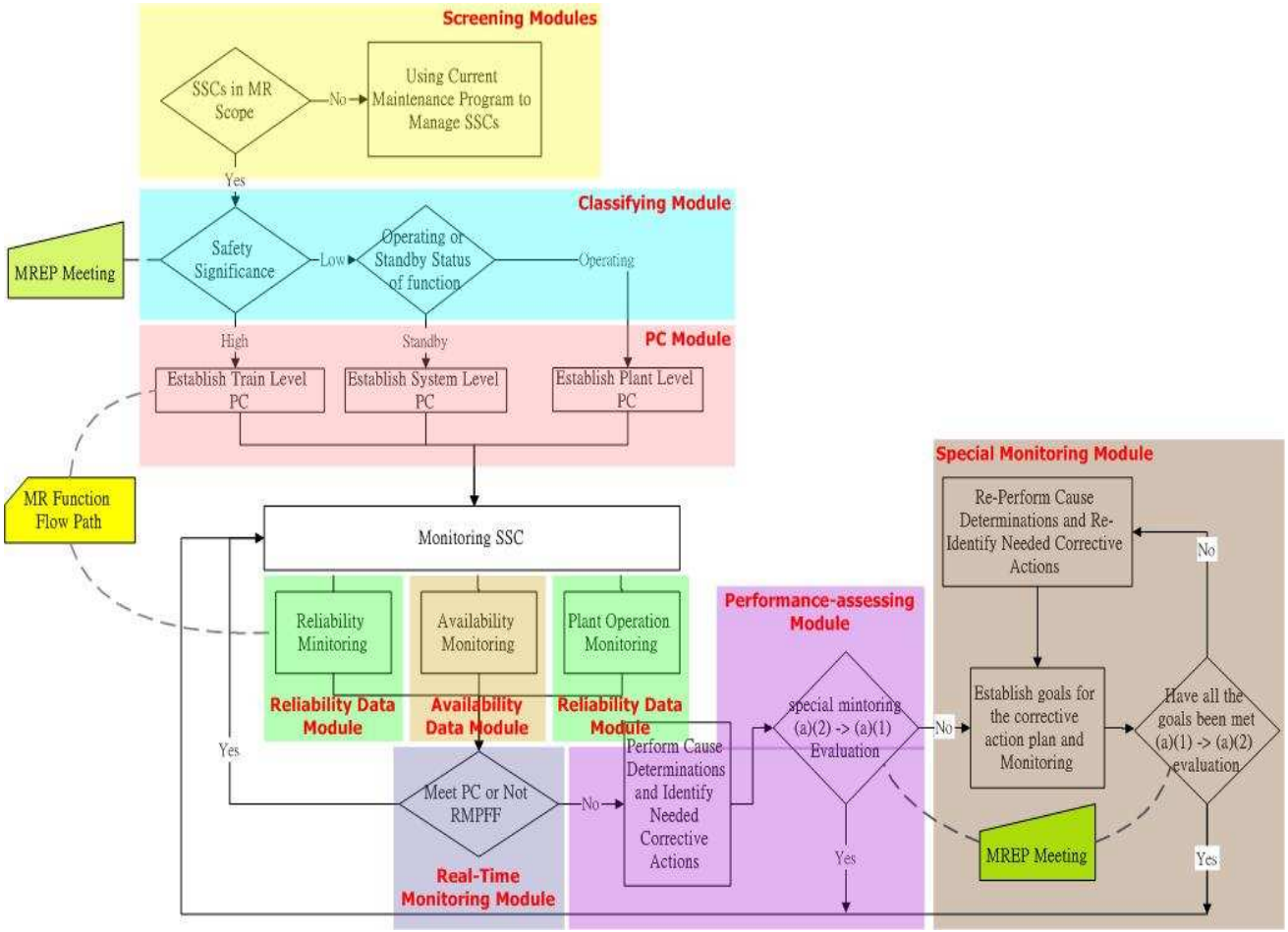
System Design

- Typically, the system design of the MEMOS is based on MR.
  - MR (a)
    - (1): SSC not meeting goals…… corrective actions needed
    - (2): SSC remains capable of performing intended function
    - (3): SSC goals and PM activities are periodically evaluated
    - (4): Before maintenance, the licensee shall assess and manage the increased risk
  - MR (b): Define scope of the monitoring program
    - (1): Safety-related SSCs
    - (2): Nonsafety related SSCs

Flow Chart of the MEMOS



Modules of MEMOS and User Interface



Screening Module

- In Screening Module, system engineer check these seven items to determine whether Structures, Systems, and Components are in MR scope or not.
- If one of them is checked, it is in MR scope.

☐ A.Safety Related

☐ Ensure the integrity of the reactor collant pressure boundary.

☐ Provide the capability to shut down the reactor and maintain it in a safe shutdown condition.

☐ Provide the capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposure comparable to the guidelines in 10CFR 100, applicable.

B.Non-Safety Related

☐ are relied upon for accident mitigation.

☐ are used in Emergency Operating Procedures to provide accident mitigation.

☐ will cause the failure of a safety-related SSC should they fail.

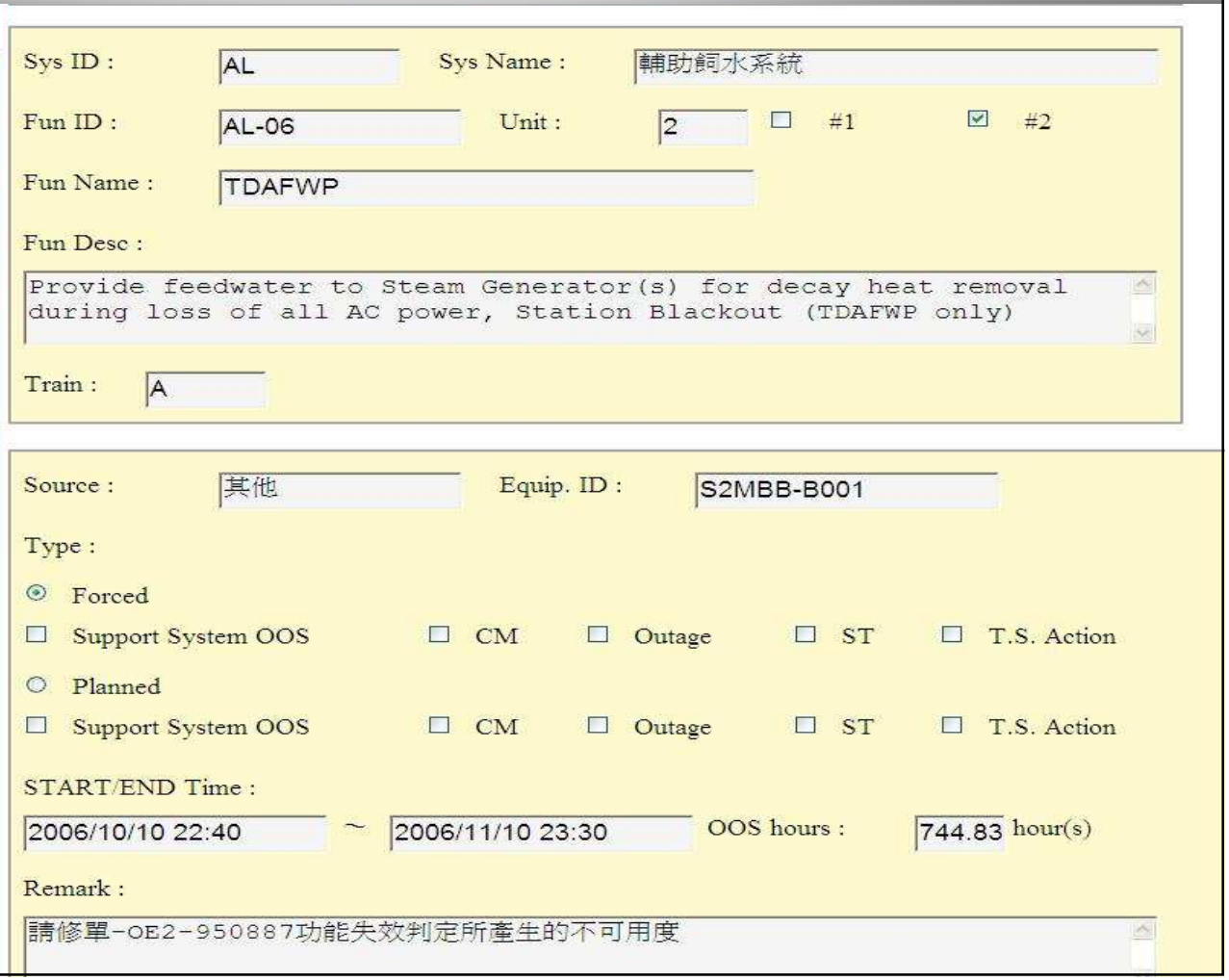
☑ will cause a reactor trip or actuation of a safety-related system should they fail.

Classifying & PC Modules

- In Classifying Module, the risk significance is based on PRA model to calculate the importance for each of the systems, or determined by MR Expert Panel.
  - RAW > 2
  - RRW > 1.005
  - FV up to 90% cut-sets
- In Performance Criteria Module, firstly collect recent 36 months data of equipments out of service hours and failure frequencies to calculate the reasonable limitation for the unavailability and reliability of each train or system by using statistics distribution.

Availability Data Module

- In availability data module, it provides users an input interface to collect the OOS types (forced or planned) and hours for each of the system function.
- Typically, the data source is from the control room log.



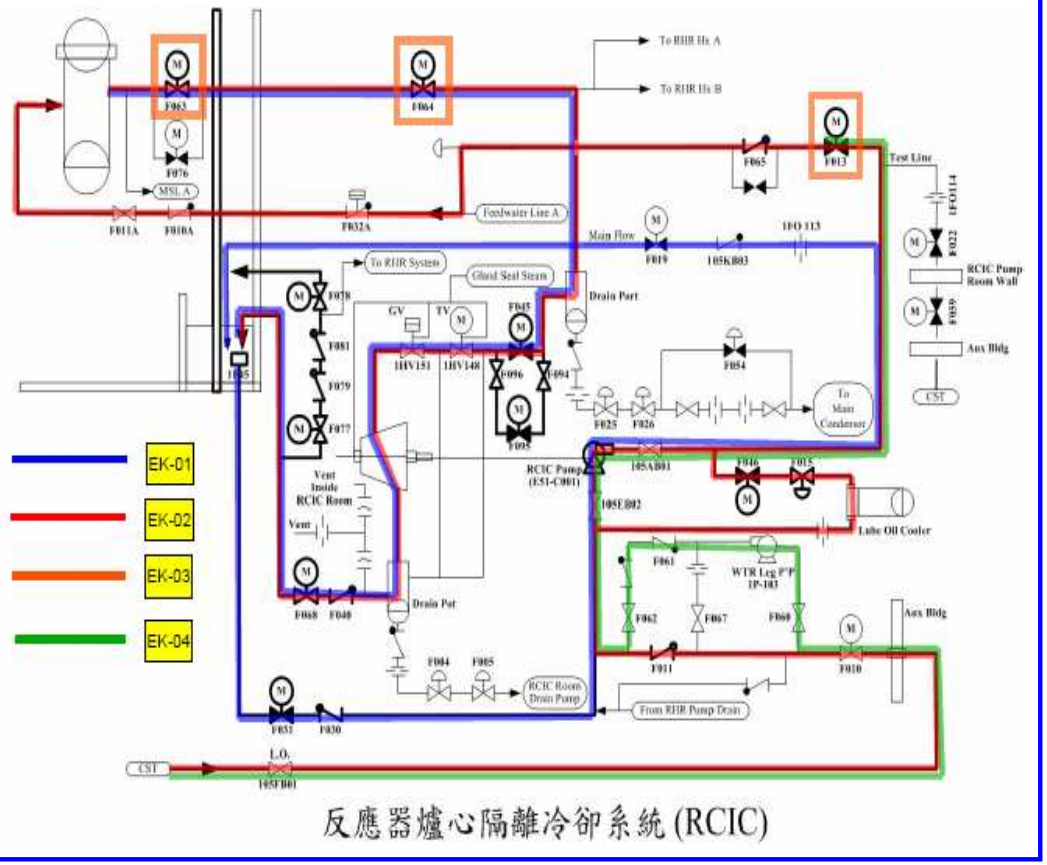
Reliability Data Module

- In reliability data module, it includes three units
  - Component-Relating Unit
  - Non Functional Failure Determining Unit
  - Functional Failure Determining Unit
- It provides an input interface for MRC to screen daily functional failure records of scoped-in MR system functions from work orders, and create a FF determination checklist for responsible engineer to fill in the details for later tracking and comparison.

Component-Relating Unit

- In component relating unit, the P&ID drawings are linkage to each system.
- Then markup the MR function flow path. For example, there are 4 flow paths in RCIC system.
- In addition, the equipments along each MR function flow paths are stored in the database.

Flow Path

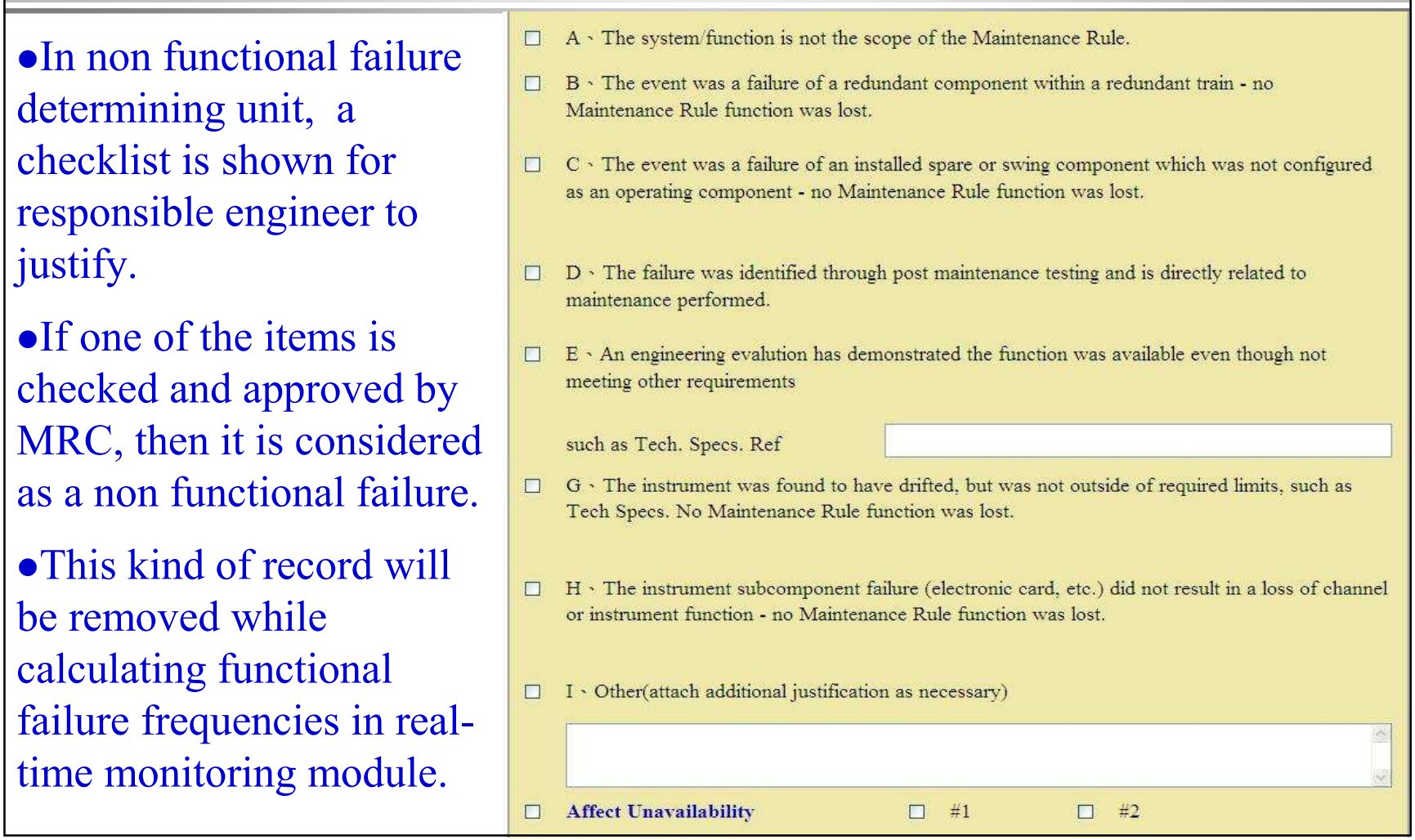


Component-Relating Unit (Cont.)

- By using linkage table, component-relating unit retrieves related MR function ID automatically while the equipment ID from work order was entered.
- For example, the equipment ID 1EK-HV-101 is linked to AP-01 and EK-02, however, the MRC still needs to determine which ones are affected.

Non Functional Failure Determining Unit

- In non functional failure determining unit, a checklist is shown for responsible engineer to justify.
- If one of the items is checked and approved by MRC, then it is considered as a non functional failure.
- This kind of record will be removed while calculating functional failure frequencies in real-time monitoring module.



☐ A、The system/function is not the scope of the Maintenance Rule.

☐ B、The event was a failure of a redundant component within a redundant train - no Maintenance Rule function was lost.

☐ C、The event was a failure of an installed spare or swing component which was not configured as an operating component - no Maintenance Rule function was lost.

☐ D、The failure was identified through post maintenance testing and is directly related to maintenance performed.

☐ E、An engineering evalution has demonstrated the function was available even though not meeting other requirements

such as Tech. Specs. Ref

☐ G、The instrument was found to have drifted, but was not outside of required limits, such as Tech Specs. No Maintenance Rule function was lost.

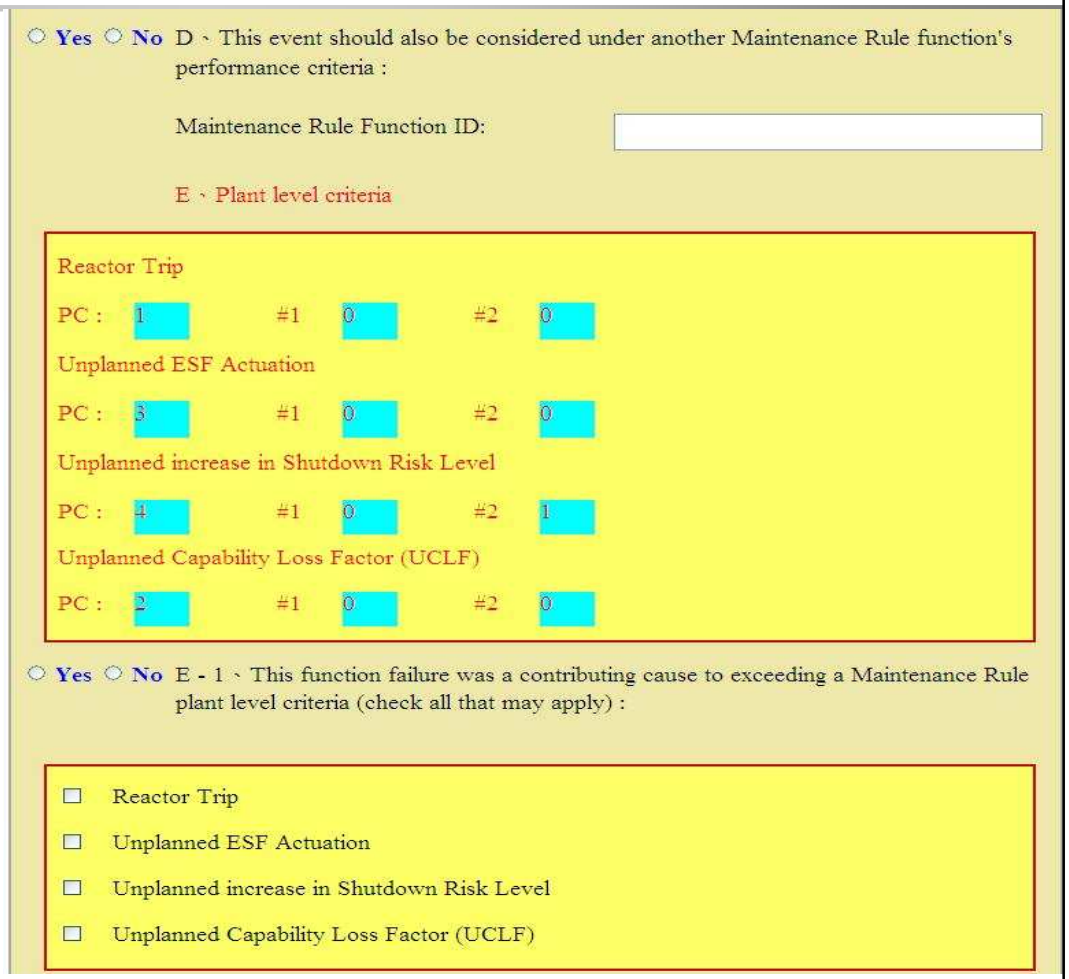
☐ H、The instrument subcomponent failure (electronic card, etc.) did not result in a loss of channel or instrument function - no Maintenance Rule function was lost.

☐ I、Other(attach additional justification as necessary)

☐ **Affect Unavailability** ☐ #1 ☐ #2

Functional Failure Determining Unit

- In functional failure determining unit, basically, the process is similar to the non functional failure determining unit.
- One big difference is the red color items display the auto-calculating result from real-time monitoring module, for example, the functional failure frequencies of plant level is shown in item E.



Real-Time Monitoring Module

- In real-time monitoring module, it retrieves data from the availability and reliability data modules continuously, and calculates the OOS hours and FF frequencies of each system function.
- The monitoring result is displayed, it helps users to get the whole picture of maintenance effectiveness at any time.

Monitoring Result

Duration : 2006/07/01 00:00 ~ 2008/01/03 23:59 Create Eval. Quit

Unit : 1

Unavailability

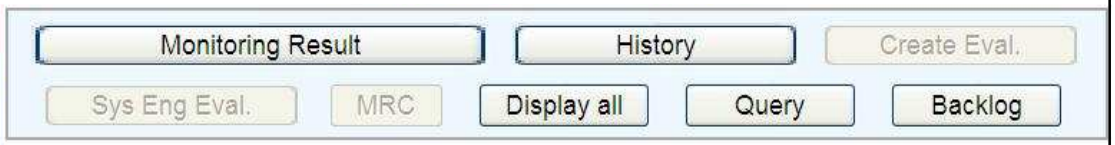
	Fun ID	Fun Name	Train	PC	OOS hours	Curve
☐	BC-05	RCS COPS	B	100	49.32	Curve
☐	GJ-01	Essential Chiller, Pump and Compression Tank	B	200	84.48	Curve
☐	NK-01	NJ 125 VDC power supply	N/A	100	133.83	Curve
☐	PE-01	emergency 4160V power supply to PB busses	N/A	100	3.58	Curve

Reliability

	Fun ID	Fun Name	Train	PC	FF counts
☐	AN-05	輔助飼水系統後備水源		2	1
☐	BC-02	ECCS function	B	1	1
☐	BC-05	RCS COPS	A	1	1
☐	BC-05	RCS COPS	B	1	1
☐	BH-07	boron concentration maintaining during refueling		2	2
☐	GG-03	fuel building Emergency ventilation		2	1
☐	GJ-01	Essential Chiller, Pump and Compression Tank	B	2	1
☐	GT-03	containment isolation		2	1

Performance-assessing Module

- In performance-assessing module, the duration of assessment is 18 months.
- It displays the current and historic performance evaluation records of the system functions for periodic assessment.
- It also provides an input interface for MRC to specify a system function is in need of special monitoring once MREP is approved.



Unit	Fun ID	Fun Name	Train	Eval. Date	Status	Sys Eng	Approval	View
2	AB-01	power generation		2006/12/04 08:00	(a)(2)	高起	核准	View
1	AB-01	power generation		2006/12/04 08:00	(a)(2)	高起	核准	View
1	AB-02	steam bypass		2006/12/04 08:00	(a)(2)	高起	核准	View
2	AB-02	steam bypass		2006/12/04 08:00	(a)(2)	高起	核准	View
2	AB-03	controlled decay heat removal		2006/12/04 08:00	(a)(2)	高起	核准	View
1	AB-03	controlled decay heat removal		2006/12/04 08:00	(a)(2)	高起	核准	View
2	AB-04	overpressure protection		2006/12/04 08:00	(a)(2)	高起	核准	View

Special Monitoring Module

- In special monitoring module, it provides a template for system engineer to download and record
  - the corrective actions and tracks the status
  - goals in the corrective action plan and the monitoring results of the goals.
- Once the goals are satisfied and approved by MREP, the system engineer uploads the report, and the process will turn to performance-assessing module.

Send	Unit	Report No	Fun ID	Fun Name	(a)(1) Date	Reporter	Approval	View	Download	Upload
	1	1-9601	AL-01	MDAFWP	2007/01/05 00:00	王昱閔	新報告	View	Download	
	1	1-9602	BG-03	RCP seal	2007/01/05 00:00	張益維	新報告	View	Download	
	1	1-9603	BG-04	containment isolation	2007/01/05 00:00	張益維	新報告	View	Download	
	1	1-9604	EF-01	NSCW non-safety-related loads	2007/01/05 00:00	黃水生	新報告	View	Download	
	1	1-9605	EF-02	NSCW safety-related loads	2007/01/05 00:00	王聰榮	新報告	View	Download	
	1	1-9606	GG-03	fuel building normal ventilation isolation	2007/01/10 00:00	張榮基	新報告	View	Download	

Conclusion

- The MEMOS streamlines the implementation process of the Maintenance Rule activities which has run for one year at the plants, it serves as a platform to monitor their daily maintenance activities under the so-called (a)(1), (a)(2) and (a)(3) requirement of the MR.
- The implementation of the MEMOS comes out with satisfactory results to fulfill the MR requirements, which will be a critical step towards improving the capacity factors and enhance the performance of NPPs in Taiwan.
- Finally, I hope the experience of MEMOS can be applied to industries.

Thanks for your attention

Pi-Lin Hsu
Institute of Nuclear Energy Research
plhsu@iner.gov.tw

ISO 9001
BSMI