

Regulation and Management of Resuming Operation Following Reactor Trouble Events in JMTR

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Introduction

The JMTR (50MWth) will restart on FY2011 after the refurbishment for new irradiation researches and utilizations such as development of next generation LWRs, production of ^{99}Mo for medical use.

Higher operating availability is indispensable to satisfy increased irradiation demand after restart. The reactor operation must therefore increase from 180 days/year to **210 days/year**.

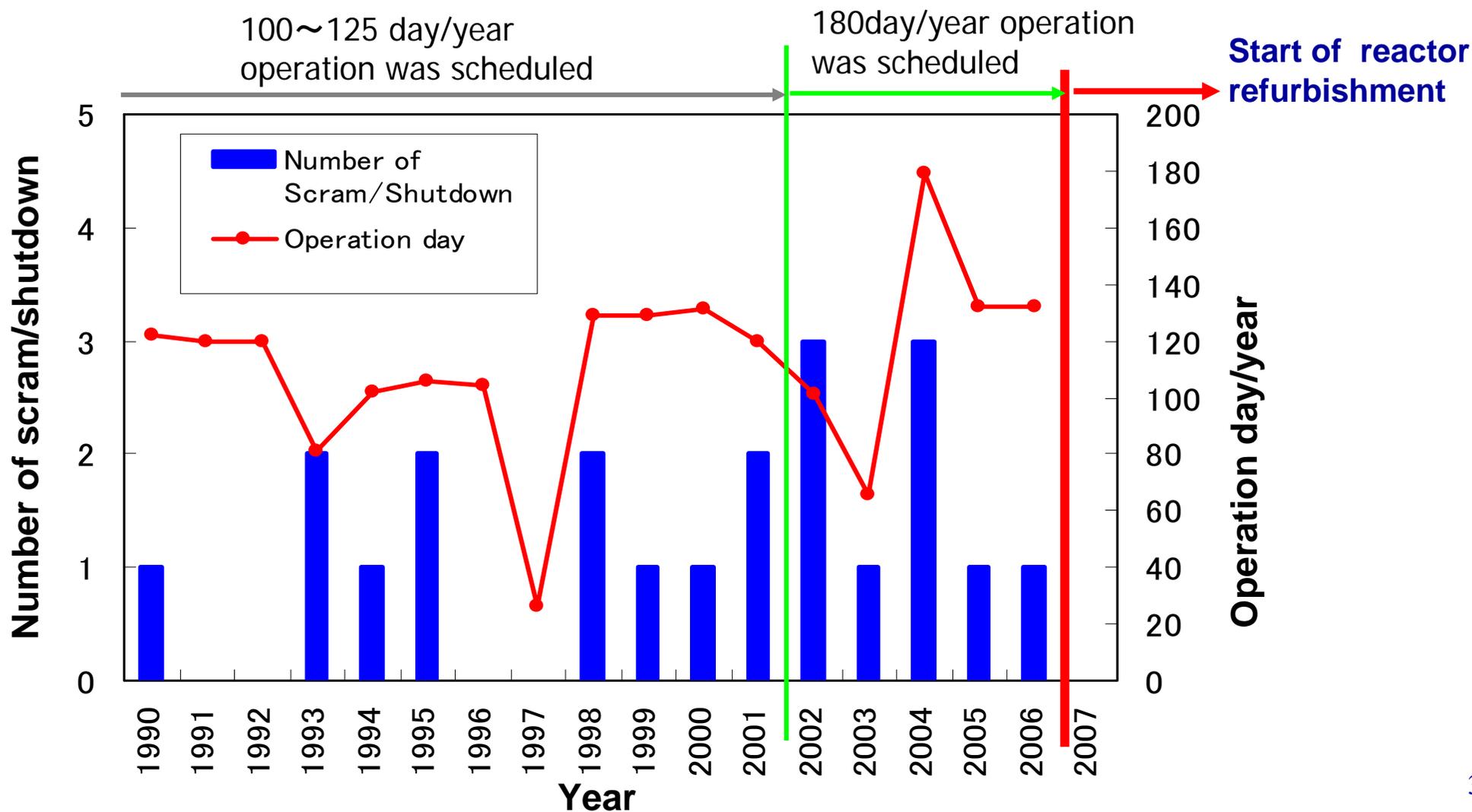
To achieve 210 days/year operation, preventive maintenance will be carried out systematically according to the maintenance plan after restart. In addition to shorten reactor maintenance time such as refueling, exchange of irradiation capsules and overhaul of reactor, it should be inevitable to shorten shutdown time caused by unexpected reactor scram.

 The scram events in the JMTR and the system of safety regulation were therefore surveyed and investigated from the viewpoint of optimization of the research and test reactor management.

Operation days and Reactor Shutdown Events in JMTR



Low frequency of scram/shutdown can not correspond to high reactor availability



Typical Reactor Scram/Shutdown Events

■ 2002.5.14 on 145th cycle

**Reactor scram by failure in electric circuit
of control rod position detector**

▪ Interruption of operation 50 days

■ 2002.12.10 on 147th cycle

**Manual shutdown by water leakage
from instrumentation pipe of primary cooling system**

▪ Interruption of operation 188 days

■ 2003.6.20 on 148th cycle

Manual shutdown by failure of irradiation facility

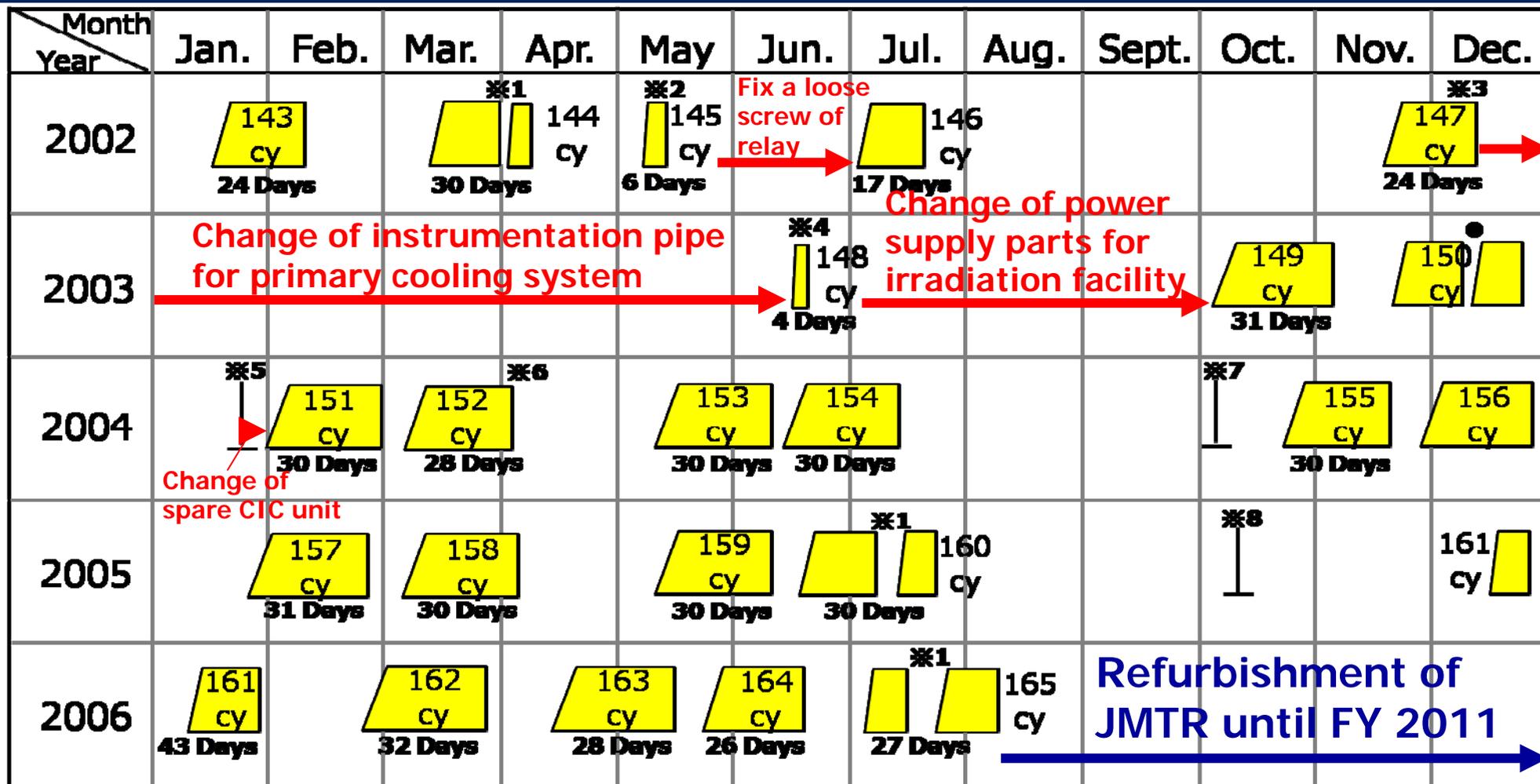
▪ Interruption of operation 105 days

■ 2004.1.29 on 151th cycle

Manual shutdown by failure of neutron detector (CIC)

▪ Interruption of operation 8 days

Operating records in JMTR (2002-2006)



- ※1 reactor scram by electric power failure for thunderbolt
- ※2 Reactor scram by failure in electric circuit of control rod position detector
- ※3 Manual shutdown by water leakage from instrumentation pipe of primary cooling system
- ※4 Manual shutdown by failure of irradiation facility
- ※5 Manual shutdown by failure of neutron detector
- ※6 Reactor scram by earthquake
- ※7 Reactor scram by operation error in pre-operation
- ※8 Incompatibility of periodical inspection

● intermediate reactors shutdown

Reactor scram by failure in electric circuit of control rod position detector (2002.05.14)



■ Content of event

Reactor scram was occurred by a scram signal of "failure of outer excitation coil to follow inner mechanism".

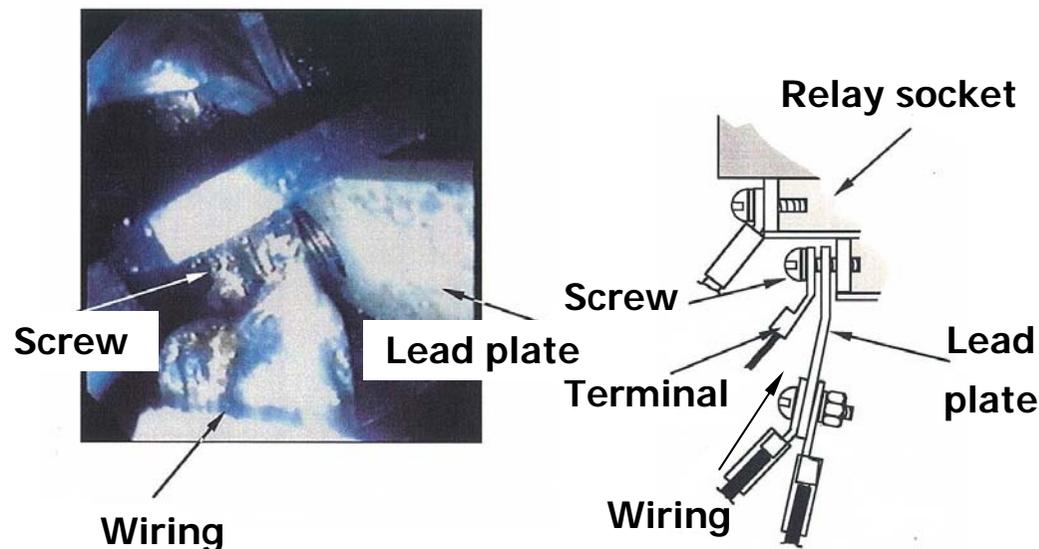
As the result of examination, a loose screw was found in the relay socket of control rod position detector. The cause was therefore a error signal due to a loose screw.

■ Corrective actions

- (1) The loose screw was fastened.
- (2) Screw conditions of all relay sockets in JMTR were checked and re-fastened.
- (3) Reinforcement of quality control (inspection process was revised).

■ Issues for enhancement of reactor availability

Intelligible explanation as to reassure of scram event, the cause and safety measures to regulatory authority.



Relay socket of control rod pos. detector

Time series

- May 14 Reactor scram. Notification to regulatory authority, immediately.
- May 15 Start of explanation of the cause and corrective actions for regulatory authority.
- June 24 Reactor scram report including the cause and corrective actions was submitted to the regulatory authority.
- July 3 Reactor restart.

Manual shutdown by water leakage from instrumentation piping of primary cooling system (2002.12.10)

1/2

■ Content of event

Water leakage from instrumentation piping was found near pressurizing pump of purification system in primary cooling system by ITV monitor, and reactor was manually shutdown by operator.

As a result of examination,
The water leakage was occurred by crack of instrumentation piping due to vibration of the pressurizing pump.
Additionally, the interval of water supply to primary cooling systems from the view point of early detection of water leakage



Water leakage near the pressurizing pump of purification system in primary cooling system

Manual shutdown by water leakage from instrumentation piping of primary cooling system (2002.12.10)

2/2

■ Corrective actions

- (1) Change of the instrumentation piping, and piping support was installed.
- (2) Another instrumentation piping of JMTR were checked, and piping supports were installed.
- (3) Improvement of water leak detector for primary cooling system room.
- (4) Improvement of operation support computer system for water leakage

Time series

- Dec. 10 Manual shutdown. Notification to regulatory authority, immediately.
- Dec. 10 Start of explanation of the cause and corrective actions for regulatory authority.
- Jan. 10 Reactor shutdown report including the cause and corrective actions was submitted to the regulatory authority.
- Jan. 11 Start of the repair (including procedure of "approval of the design and construction method" concerning the repair).
- June 6 Complement of the repair work.
- June 17 Reactor restart.

■ Issues for enhancement of reactor availability

- Intelligible explanation as to reassurance of reactor shutdown event, the cause and safety measures to regulatory authority.
- Shortening of procedure of "approval of the design and construction method"

Manual shutdown by failure of irradiation facility (2003.06.20)

■ Content of event

On operation of irradiation facility of water environment control system for LWR water conditions, The Low pressure alarm of surge tank was occurred, and it was confirmed that Water leakage from safety valve was found by ITV monitor.

Examination and recovery were attempt. However water leakage could not stopped. Furthermore, it was found that the possibility of deviation form irradiation conditions requested by customer.

Reactor was therefore shutdown manually by operator.

As a result of examination, the event was occurred by failure of the power supply unit for control of pressure control valve.



Floor of loop cubicle room for water environment control system



Valve occurred water leakage

Manual shutdown by failure of irradiation facility (2003.06.20)

This event is no impact on reactor operation or reactor safety

2/2

■ Corrective actions

- (1) Change of the power supply unit.
- (2) All of the power units with same type in JMTR were checked.
- (3) Improvement of water environment control system from the viewpoint of water leakage

■ Issues for enhancement of reactor availability

- Intelligible explanation as to reassurance of reactor shutdown event, the cause and safety measures to regulatory authority.
- Management and control basis on distinction from the view point of impact of reactor operation or reactor safety.

Time series

- June. 20 Manual shutdown. Notification to regulatory authority, immediately.
- June. 23 Start of explanation of the cause and corrective actions for regulatory authority.
- July. 29 Report to the regulatory authority for the cause and corrective actions.
- periodical inspection of JMTR
- Oct. 4 Reactor restart.

Manual shutdown by failure of Neutron detector (CIC) (2004.01.22)

Content of event

On power up stage of operation, it was found that the failure of neutron counting rates of CIC. Examination was attempted, and it was found that the reason was deterioration due to aging.

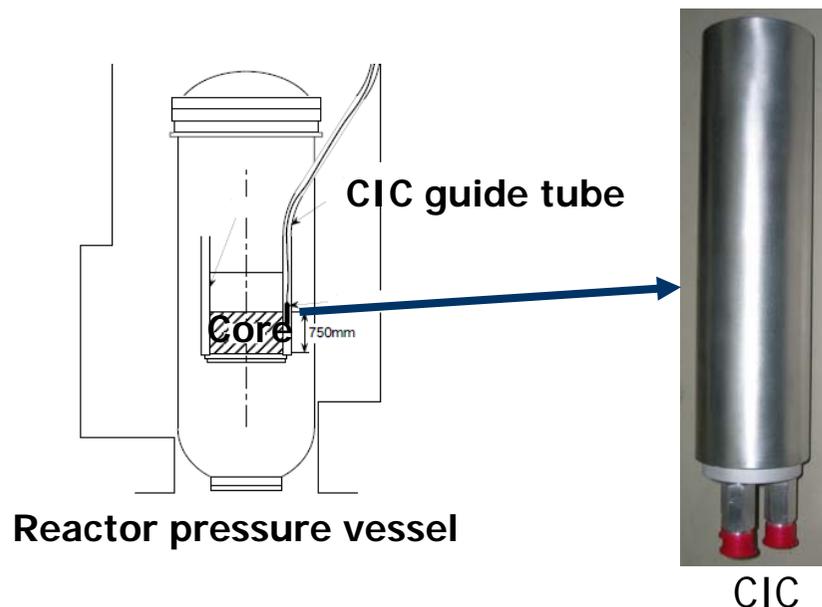
Reactor was therefore shutdown manually by operator.

Corrective actions

- (1) Change of the CIC unit.
- (2) Another CICs (consists of 3 unit of CIC for linear power channels in JMTR) were checked.
- (3) Improvement of reactor support computer for early detection of sign of aging with CIC.

Issues for enhancement of reactor availability

- Secure of spare parts
- Intelligible explanation as to reassurance of reactor shutdown event, the cause and safety measures to regulatory authority.



Time series

- | | |
|---------|----------------------------------------------------------------------------------------------------------------|
| Jan. 22 | Manual shutdown. Notification to regulatory authority, immediately. |
| Jan. 23 | Start of explanation of the cause and corrective actions for regulatory authority, and Start of change of CIC. |
| Jan. 26 | Completion of change of CIC. |
| Jan. 29 | Report to the regulatory authority for the cause and corrective actions. |
| Jan. 31 | Reactor restart. |

Reactor scram by commercial power failure (2006.07.15)



■ Content of event

Reactor scram was caused by commercial power failure because of thunderbolt to electric power line of power company.

■ Corrective actions

(1) Check to the reactor facility.
(no failure)

■ Issues for enhancement of reactor availability

- Notification or report to regulatory authority.

(Several hours requires to respond notification of scram and report of check results of reactor facility. JMTR reactor has only 1~2 hours for restart related to accumulation of Xenon.)

Time series

July. 15 Reactor scram. Notification to regulatory authority, immediately.
July.15 Report the result of reactor facility check for regulatory authority.
July. 17 Reactor restart.

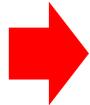
Standard of report to regulatory authority

- Shutdown events of Research and test reactor in Japan -

Enforcement on 2004

Events required for report legally

- Reactor scram, unplanned manual reactor shutdown
(Except for the event caused by earthquake, commercial power failure, aging of equipments which can be recovered by spare parts, etc.)
- Failure of important equipment for ensuring safety, etc.



- Notify the regulatory authority of the event by telephone and so on, immediately (within 15 minutes).
- Report of the conditions and countermeasures of the event to the regulatory authority by the document within 10 days.

Events with social influence

- Unplanned manual reactor shutdown except of above events
(applicable to the case of no impact on reactor operation or reactor safety such as change of spare parts, etc).



- Notification immediately
- Report of the conditions and countermeasures of the event to the regulatory authority

Summary

As the analyses results of scram events of JMTR, the issues of enhancement of reactor availability in Japan material test reactors is as follows;

- **Intelligible explanation as to reassurance of reactor shutdown event, the cause and safety measures to regulatory authority.**
- **Secure of spare parts.**
- **Shortening of procedure of “approval of the design and construction method” to repair reactor parts or components.**
- **Management and control basis on distinction from the view point of impact of reactor operation or reactor safety.
(The concept or design of material test reactors is different from ones of commercial power reactors.)**
- **Notification or report to regulatory authority.
(Several hours requires to respond notification of scram and report of check results of reactor facility. JMTR reactor has only 1~2 hours for restart related to accumulation of Xenon.)**