CONCLUSIONS

Current experience indicates that design proposals for new reactors should pay particular attention to access, inspectability and replaceability. Because the environment experienced by components in large sodium cooled fast reactors represents a major departure from that in conventional generating plant and thermal reactors, these requirements for LMFBRs should be kept under constant review during the development stages.

Since outage costs can be very high, advantage should be taken of any significant reduction in outage times that can come from early warning, from in-service inspection and monitoring, of developing faults and deterioration processes which could result in component failure.

REVIEW OF ACTIVITIES RELEVANT TO IN-SERVICE INSPECTION

N. IMANAKA
Power Reactor and Nuclear Fuel Development Corp.
Akasaka, Minato-ku, Tokyo,
Japan

1. Introduction

Nuclear power plants are requested to provide continuing safety that cannot compare with other industries, as plant safety is a matter of much concern.

To provide continuous assurance for plant safety there is increasing tendency to demand much of inspection of components during the lifetime.

This inservice inspection of LMFBRs should be investigated from a view point of different systems and characteristics from LWRs.

In this paper a review for inservice inspection of LMFBRs is described.

2. Definition of the term "Inservice Inspection"

There is no definition of the term "Inservice Inspection" in Japanese official use except only in the JEAG (Japan Electric Association Code) non-destructive examination (visual, surface and volumetric examination) is required as a Inservice Inspection of LWRs.

Judging from the object of Inservice Inspection that is to provide a continuing assurance that the components important for plant safety are

safe, there is no necessity to limit the Inservice Inspection to the nondestructive examination.

Therefore the term of Inservice Inspection in this paper is applied as a general term embracing examination made during shut-downs ("periodic inspection"), devices operating continuously throughout operation ("continuous monitoring devices"), test or devices applied periodically under operational conditions ("periodic operational testing") and materials surveillance based on the Summary Report of the last Specialist Meeting held on March, 1976 at Bensberg.

3. Inservice Inspection requirement

In Japan, Inservice Inspection of the structural parts for the nuclear power plant is obliged by the MITI (Ministry of International Trade and Industry) notification as one of the periodic inspection. It provides general requirement only to assure that the components are kept well similarly to the state at the preoperational test. Supplementing to this Japan Electric Association had provided the detailed code for LWRs.

As to the LMFBR, there being no rule except MITI notification, it might be necessary to negotiate with licensing agency in detail.

Apart from the legal requirement, the needs of Inservice Inspection should be investigated as a technical matter.

Though the components in nuclear power plant should be designed, manufactured and erected with the latest knowledge and techniques, specially for a relative new system such as a LMFBR it is difficult to collect sufficient experimental data to be able to predict with sufficient accuracy component behaviour during its lifetime.

Therefore, there remains some uncertainty from engineering point of view. Inservice Inspection should be settled as to compensating these uncertainty.

To inspect the components after operation for preventing their failure are effective to continue the plant operation, still they have two different meaning for the object.

The first is related to the safety, for protection of the public or the operators from radioactive hazard avoid the failure of the components essential for the protection of the public safety.

The second is concerned with plant availability and economical view point which is to minimise plant outage and repair costs, detect the failure of major components as fast as possible.

These separately directed two sort of inspection are almost same in practice, however in contrast to the former is the owner's duty, the latter may be imposed by the owner and is not within the scope of this paper.

4. Inspection aspects specific to LMFBRs

Sodium cooled reactor possesses different characteristics as to the LWRs, mostly of these makes Inservice Inspection of LMFBRs difficult to apply the same technique as LWRs, however some of these are advantageous ones from an inspection standpoint. They are;

1) Sodium has a very low vapor pressure at the operating temperature. Therefore sodium system can operate at low pressure. This makes if some crack on the components had originated, propagation of it is probably very time consuming.
2) The principal structural materials forming the coolant baundaries are austenitic stainless steel which possesses good toughness and ductility and has no tendency to cause brittle failure.
3) Sodium reacts with the oxygen in air or water, and is also good conductor of electricity.

Because of above features very small leaks are capable of being detected with sufficient time under operating conditions, accordingly the leak detection should become the main technique for the Inservice Inspection of LMFBRs.

5. Inservice Inspection plan for MONJU

Inservice Inspection plan for MONJU is not decided yet in detail, and is now underway on the basis of following consideration.

1) To reduce the plant outage time, continuous monitoring system shall be applied as much as practicable.
2) To take off a part of integral structure for inspection is not allowed.
3) Inspection methods are limited to the reliable ones that are conventional or expected to put to use in near future. The methods only depending on the future development are eliminated.
4) The detector which might malfunction must provide redundancy and/or diversity.

According to the above basis the general approach of Inservice Inspection of MONJU is as follows.

1) Reactor coolant boundaries

To detect the reactor coolant from leaking out of boundaries, continuous monitoring will be applied on the primary heat transfer system. Leak detector will be provided in guard vessels, piping and component insulation

annuli and cells containing coolant containing components. Visual examination also will be performed to locate and evaluate leaks detected by the leak detection system. Specially to the IHX tube, leak from the secondary loop to the primary loop is monitored by the level gages installed on the overflow tanks of primary and secondary loops.

2) Core support structure

The integrity of core support structure is important on the viewpoint of not only for the core configuration but for core cooling capability. There is no way to assure the integrity of the structure but materials surveillance test. Additional monitoring system is studying.

3) Guard vessels

The guard vessels are provided as "second vessels" such that an adequate level of sodium is maintained in the reactor vessel to ensure core cooling should a leak develop in any of the primary loop components. Therefore it is important to assure the integrity of the guard vessels for plant safety.

It is impossible to apply the continuous monitoring on the guard vessels as they are empty under operating condition. Should it require the Inservice Inspection, periodic inspection must be applied.

6. Conclusion

To provide a continuous assurance of safety to the LMFBR, it is essential to develop how to construct the components to maintain the integrity throuout the service lifetime. Especially how to design is urged for this object.

Inservice Inspection should be located only to compensate some uncertainty remained at the design stage, as it is too much complex in practice.

As for inspection techniques, leak monitoring is assumed to be a best way to assure the plant safety continuously with the minimum plant outage time and minimum radioactive hazard to the inspectors.