

Demonstration of Zinc Injection Technique in Fugen Nuclear Power Station



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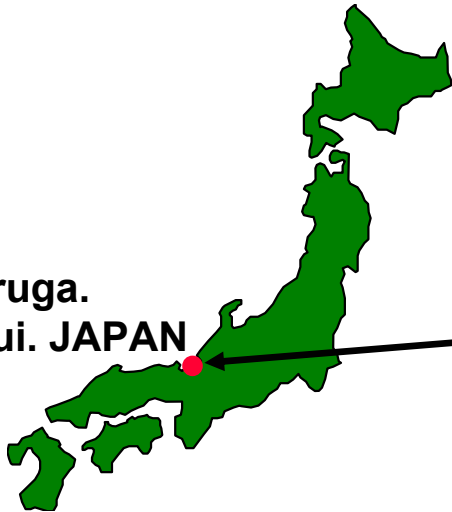
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Fugen Nuclear Power Station

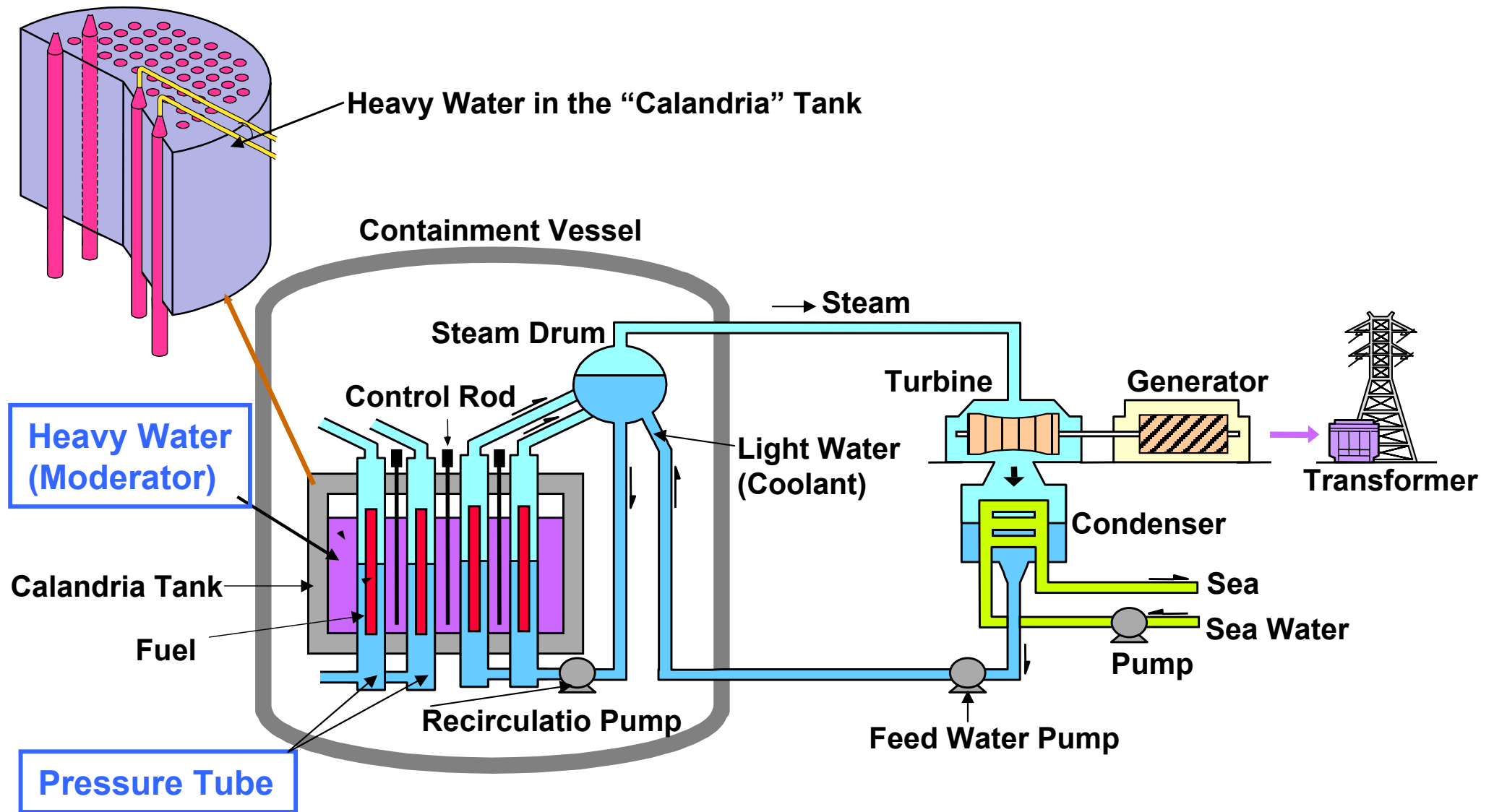
- Heavy-water-moderated, boiling light water cooled, pressure tube type reactor
- 165 MWe [Prototype Advanced Thermal Reactor(ATR)]
- Pu-U mixed oxide fuel
- Commercial operation since 1979
- Average load factor: ~ 65%
- Permanent shut down: 2003

Tsuruga.
Fukui. JAPAN

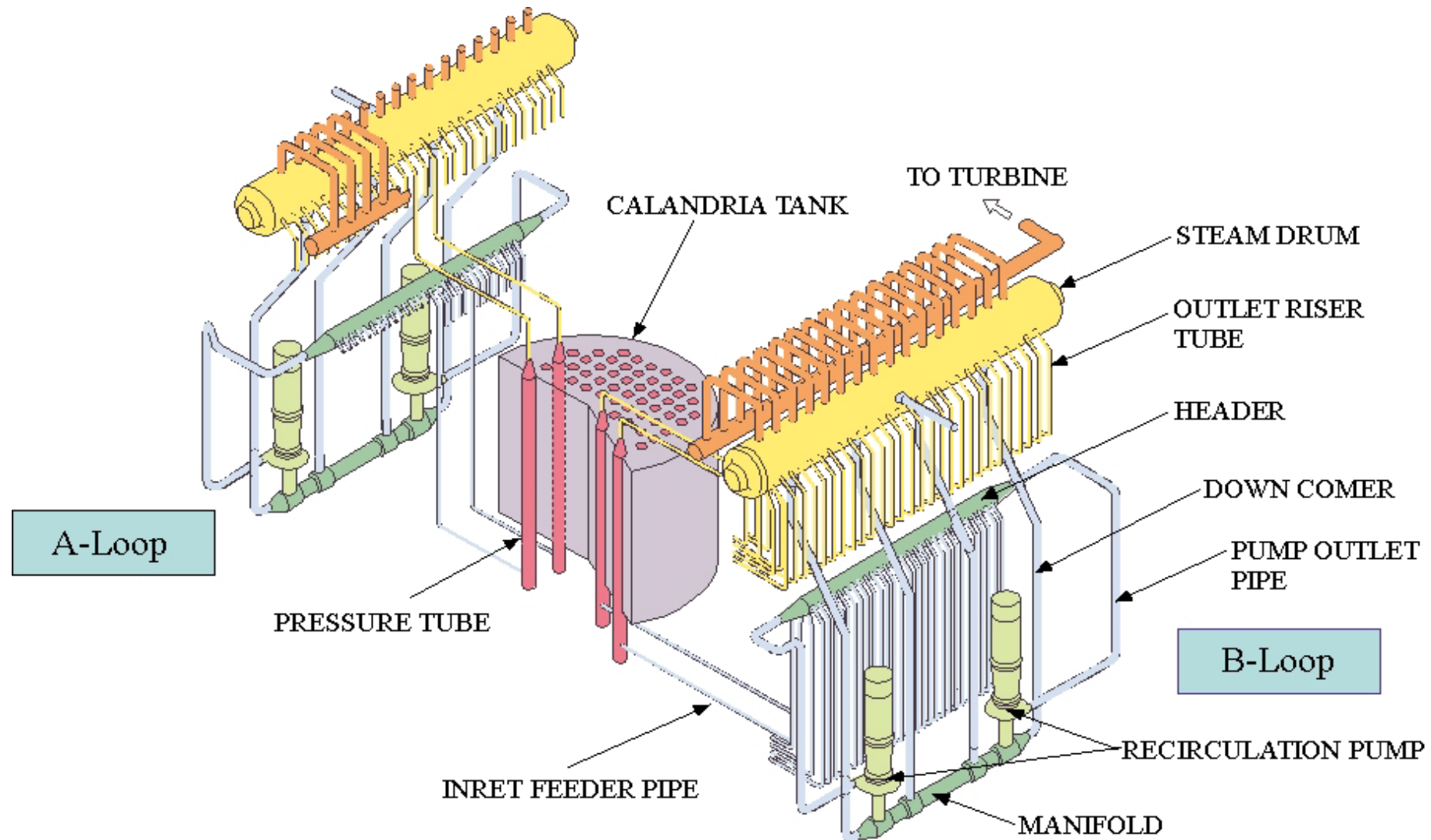


Fugen Nuclear Power Station, JAEA-3

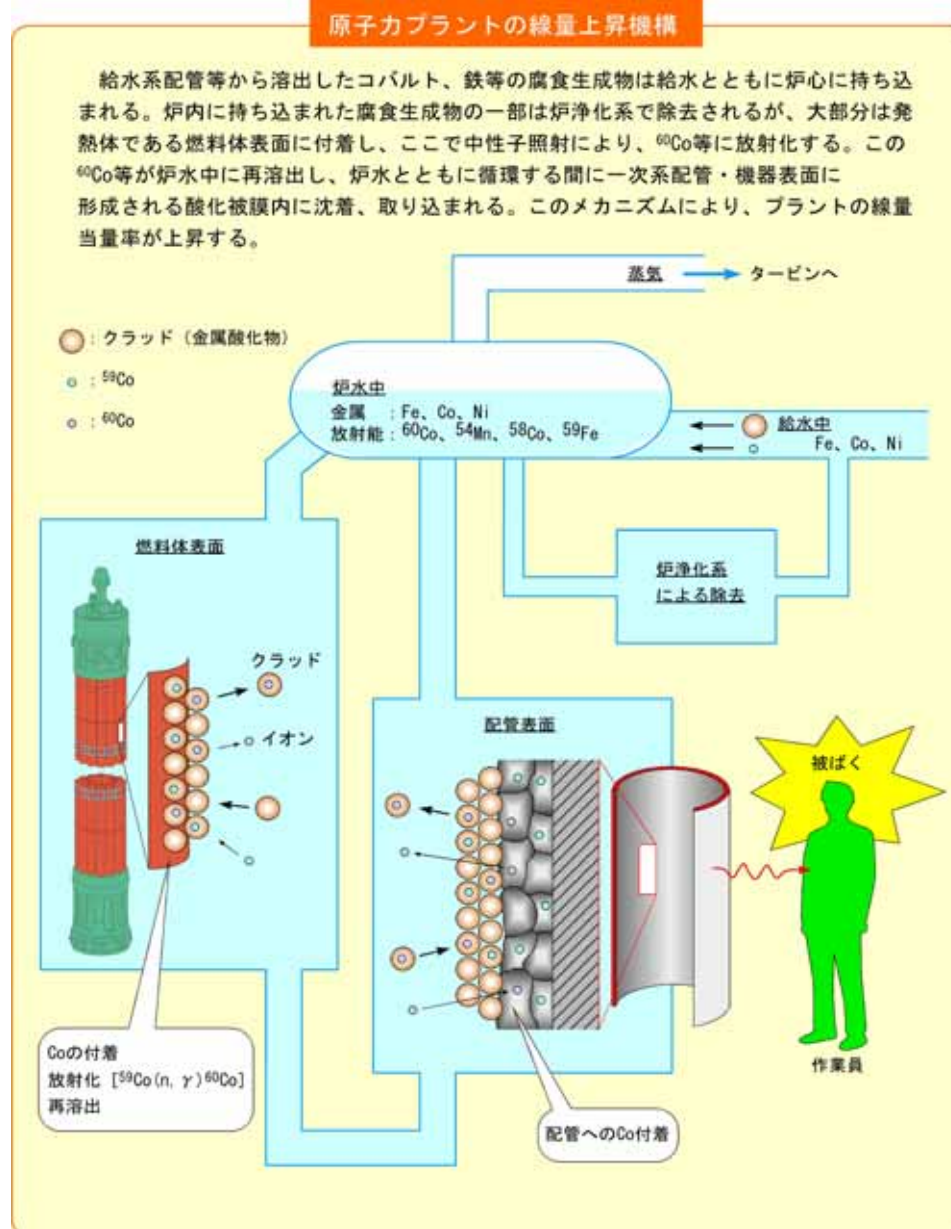
Outline of FUGEN



An Overview of Primary Cooling System

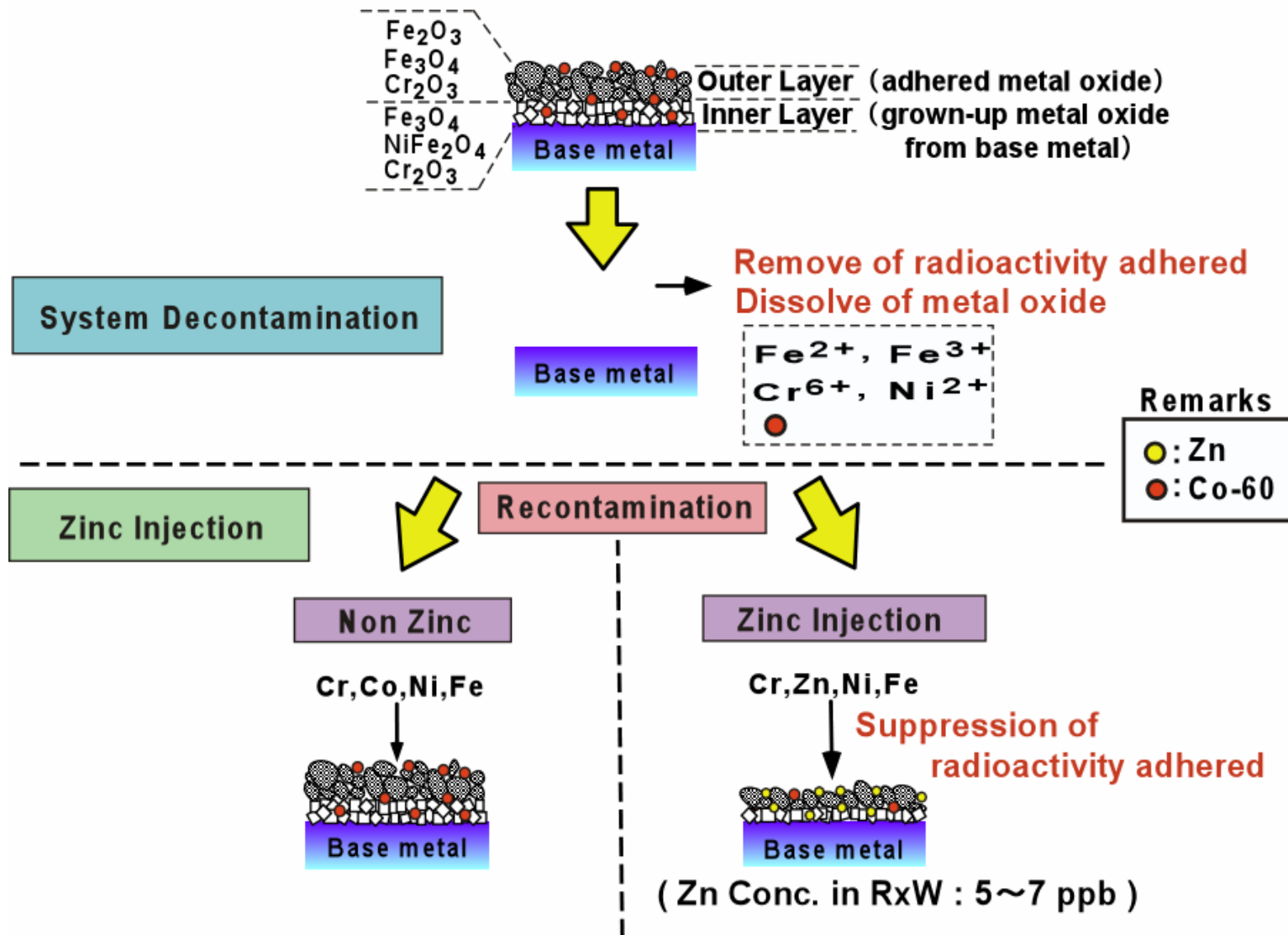


Radiation Dose Rate Rise Mechanism of Reactor Cooling System



Nuclide	Half-life	Reaction
^{60}Co	5.3 year	$^{59}\text{Co}(n, \gamma)$
^{58}Co	72 day	$^{58}\text{Ni}(n, p)$
^{59}Fe	45 day	$^{58}\text{Fe}(n, \gamma)$
^{54}Mn	310 day	$^{54}\text{Fe}(n, p)$
^{51}Cr	28 day	$^{50}\text{Cr}(n, \gamma)$

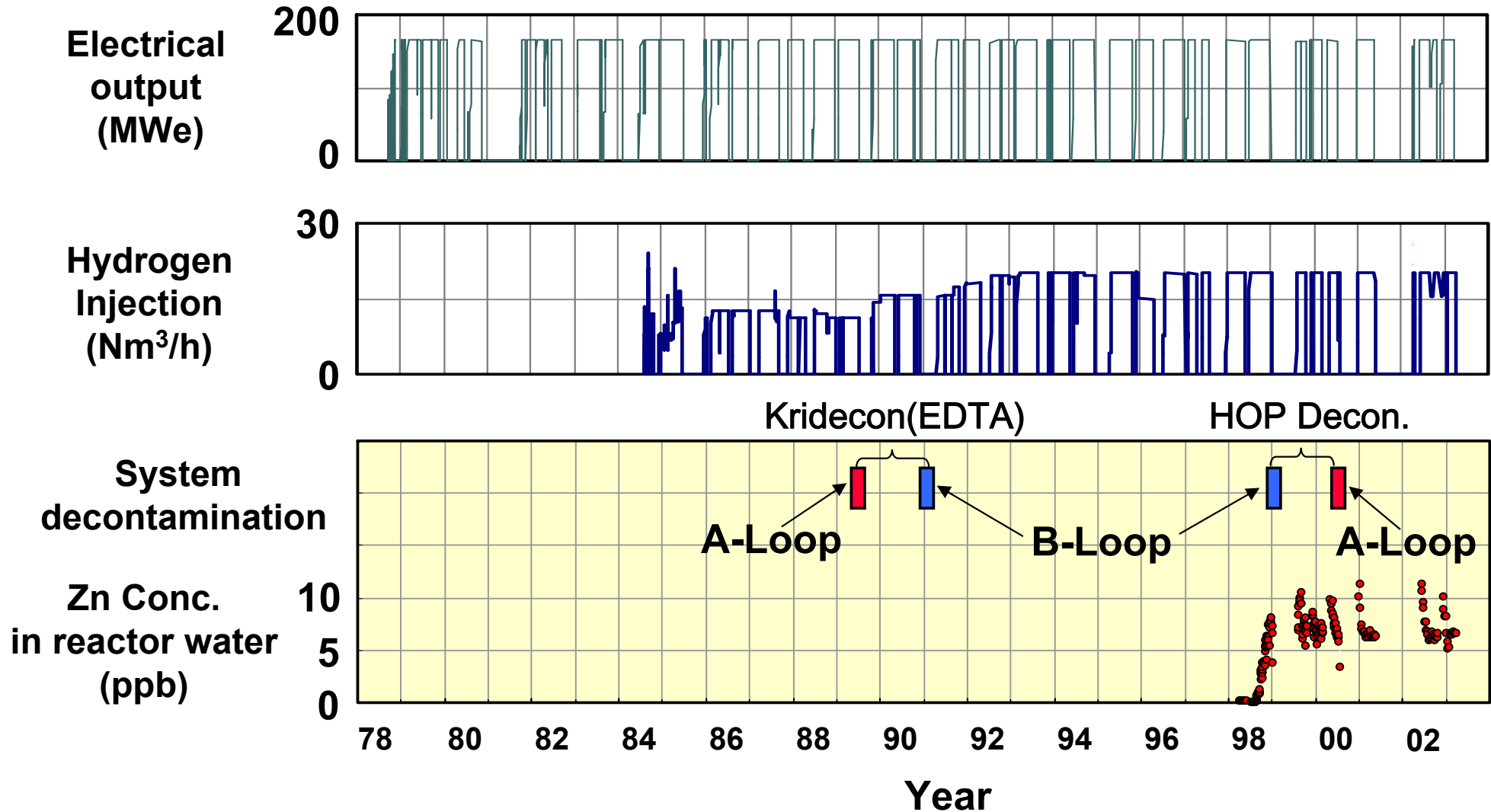
Dose Rate Reduction by Chemical Decontamination and Zinc Injection



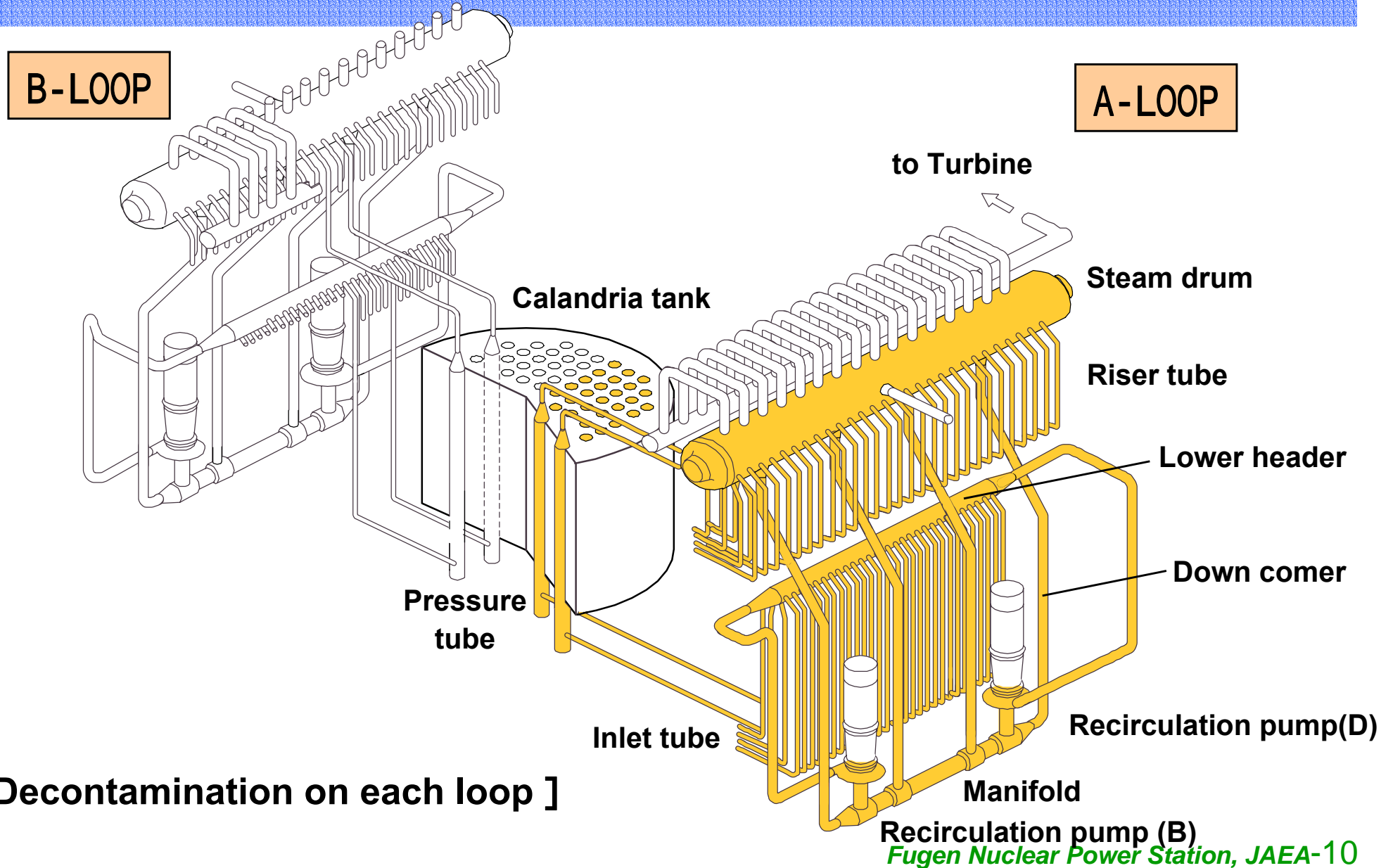
Water Chemistry Features of Fugen

- **Material integrity**
 - **HWC (1984.7 ~ 1985.7 : experimental HWC)**
(1985.12 ~ 2003.3 : HWC)
- **Occupational dose reduction**
 - **Chemical decontamination**
(1989, 1991, 1999, 2000)
 - **Zinc injection**
(1998.8 ~ 1999.1 : experimental Zn Inj.)
(1999.8 ~ 2003.3 : continuous Zn Inj.)

Application Timing of Decontamination with Water Chemistry History in Fugen

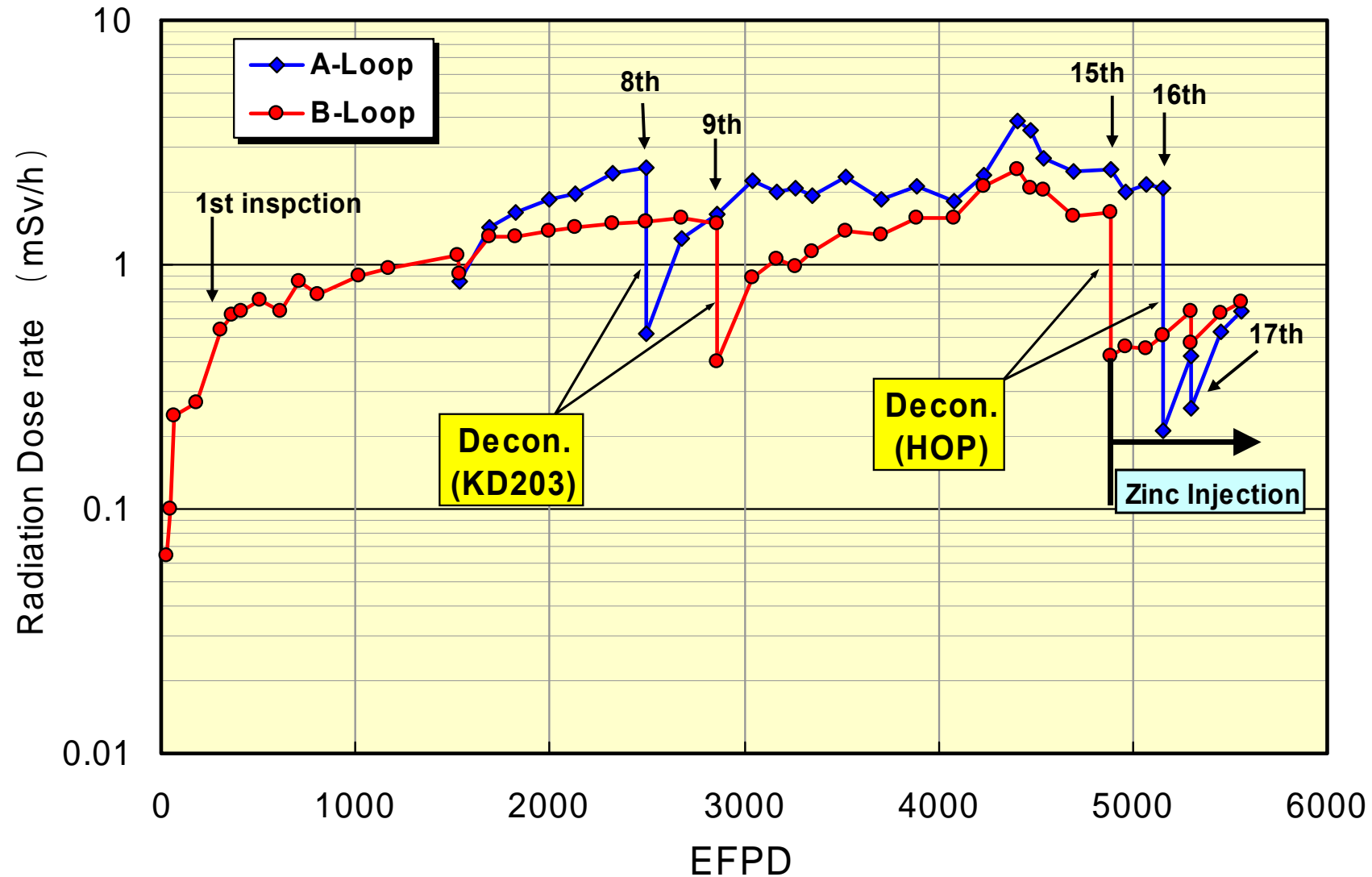


Area of Decontamination

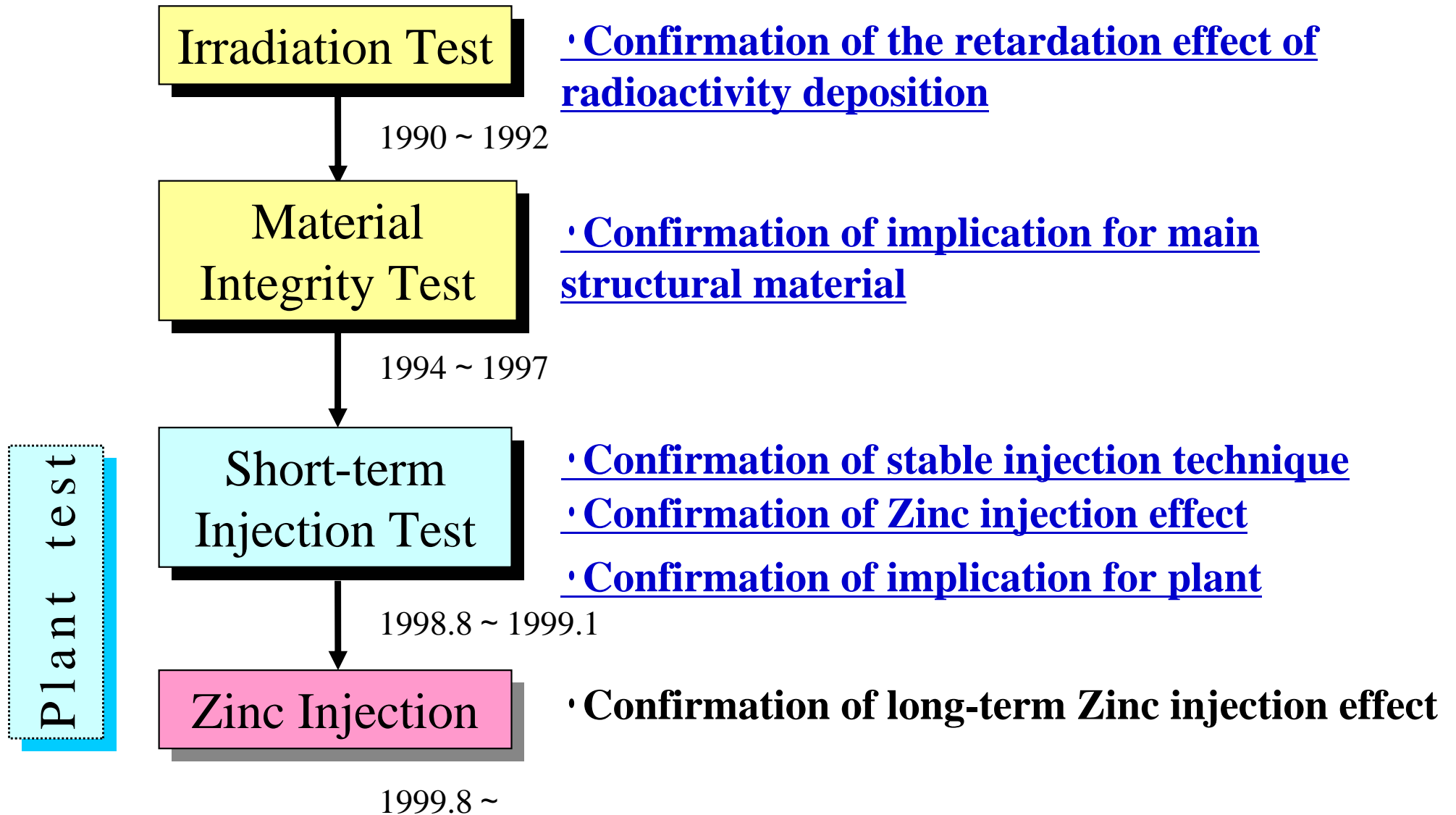


[Decontamination on each loop]

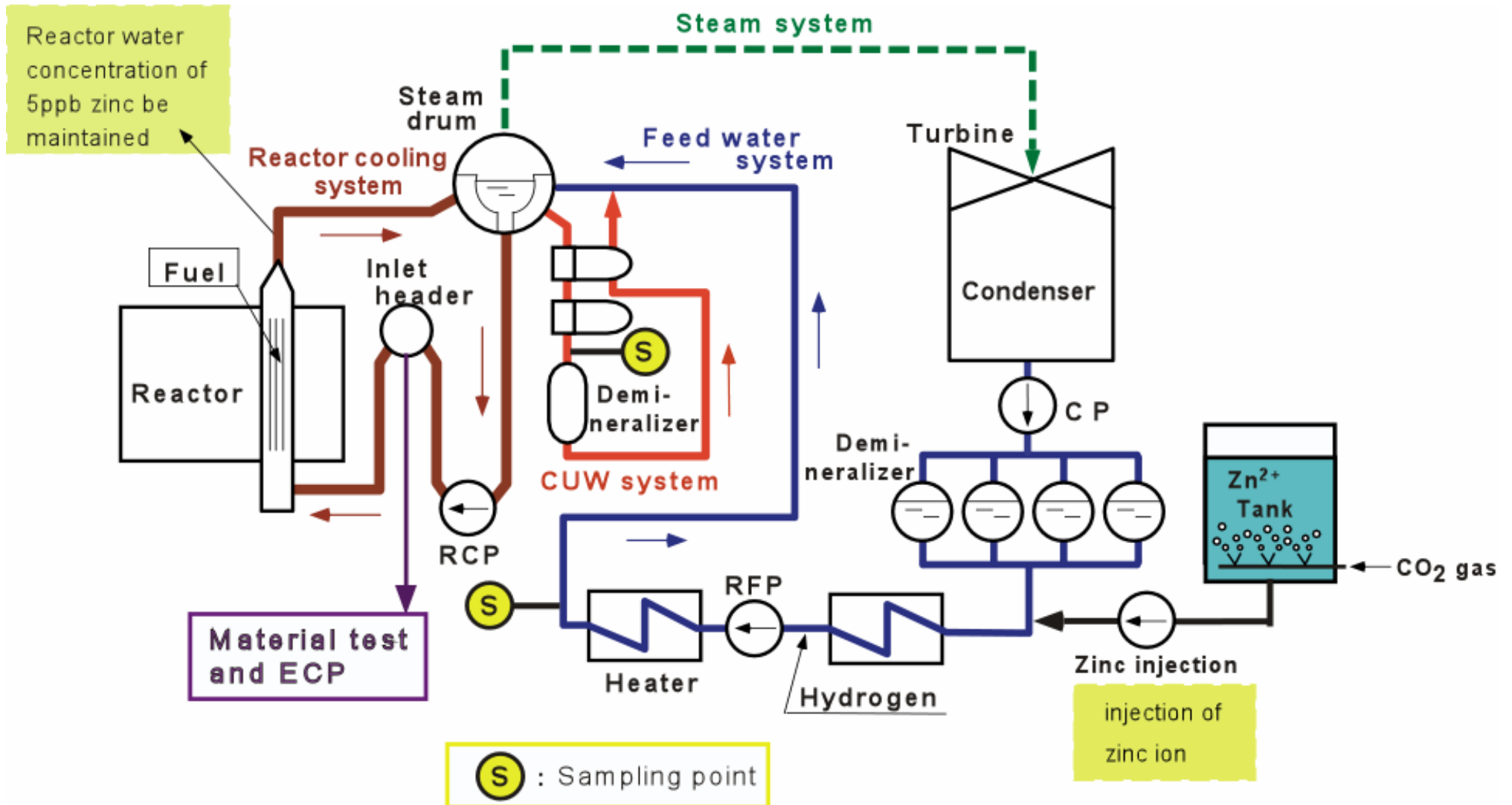
Doserate Change of the Reactor Coolant Recirculation Pump Outlet Pipe



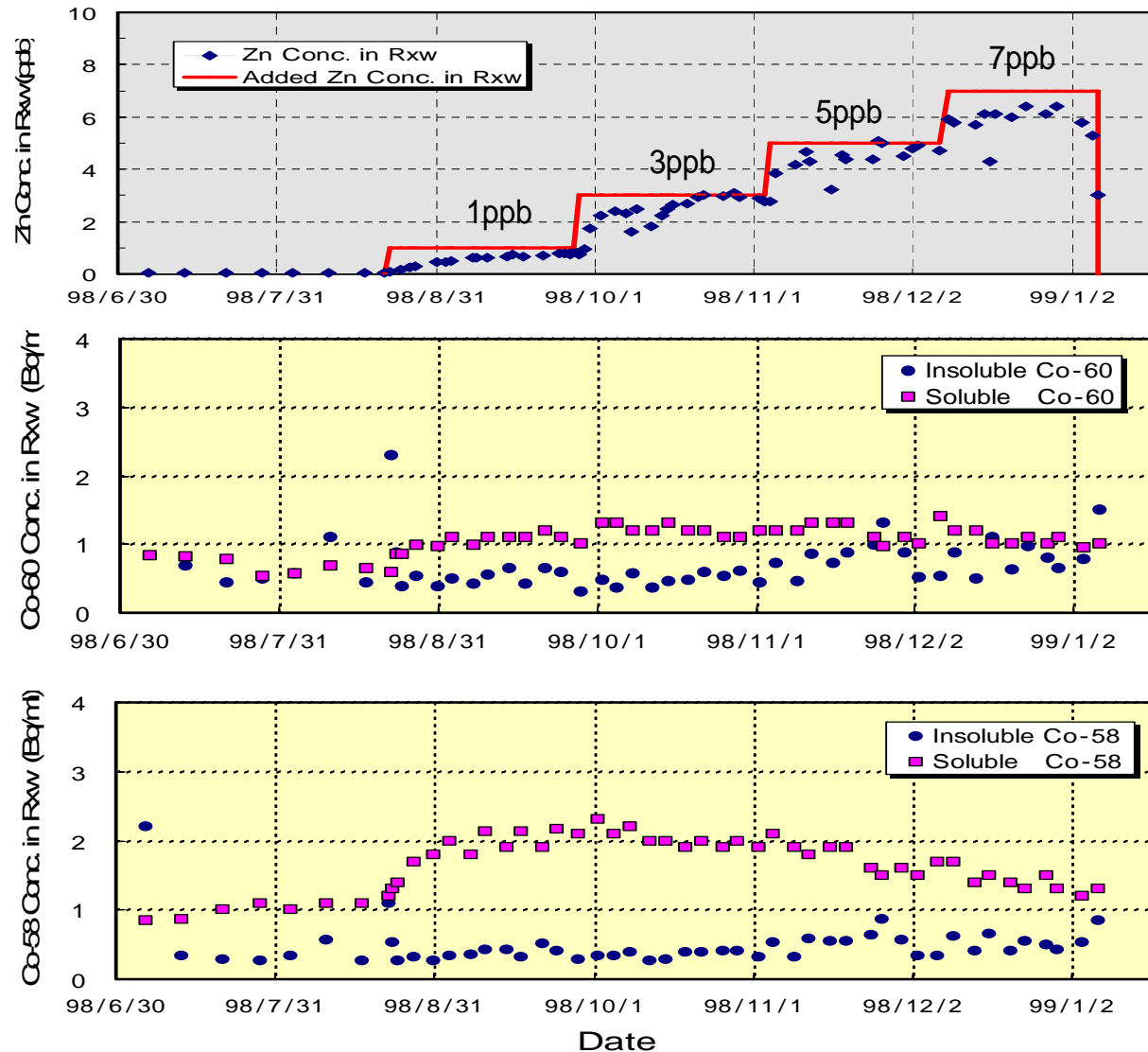
Preparations for Zn Injection in Fugen



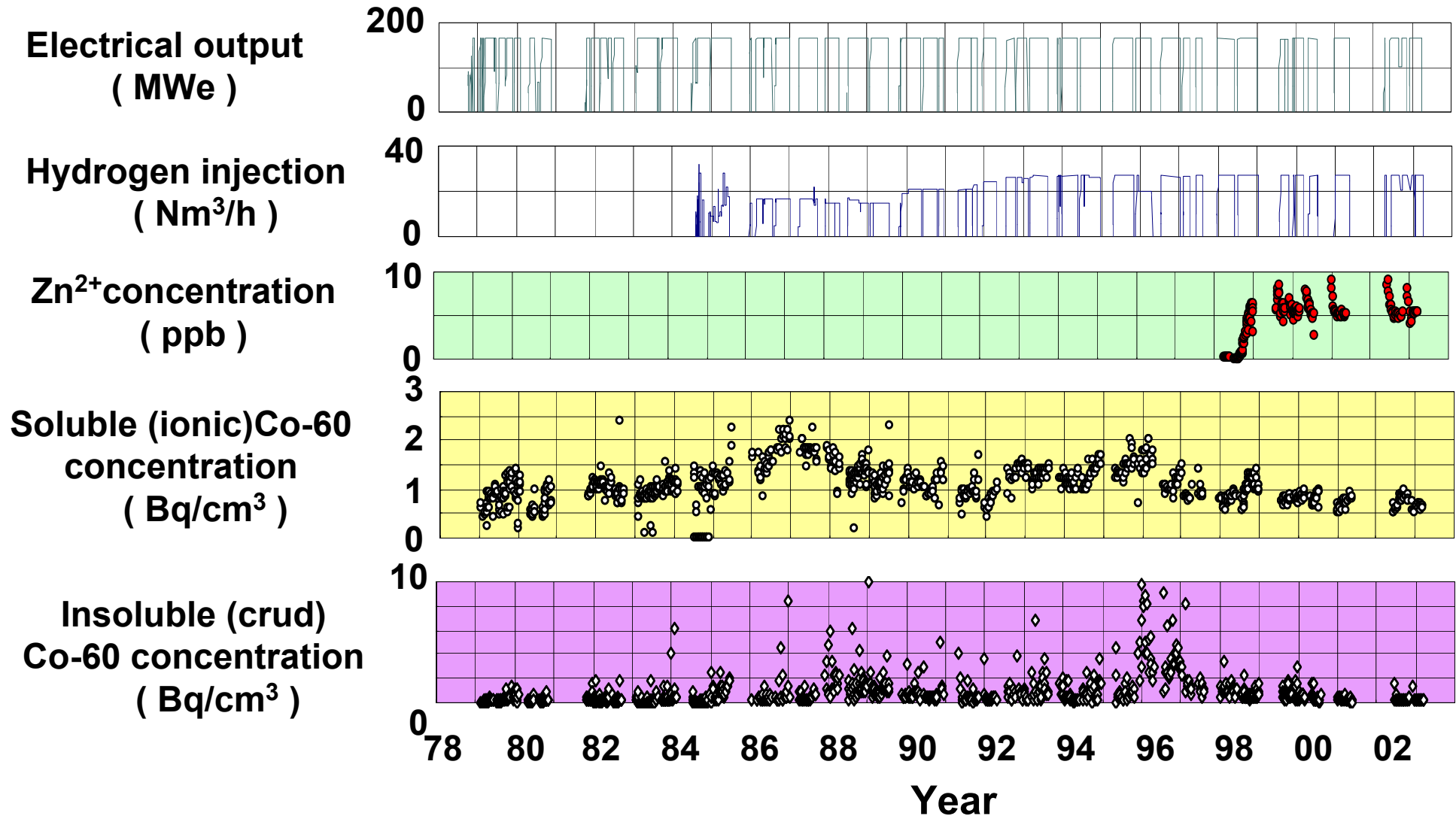
Flow Schematic of Zinc Injection in Fugen



Activity Change During Zinc Injection



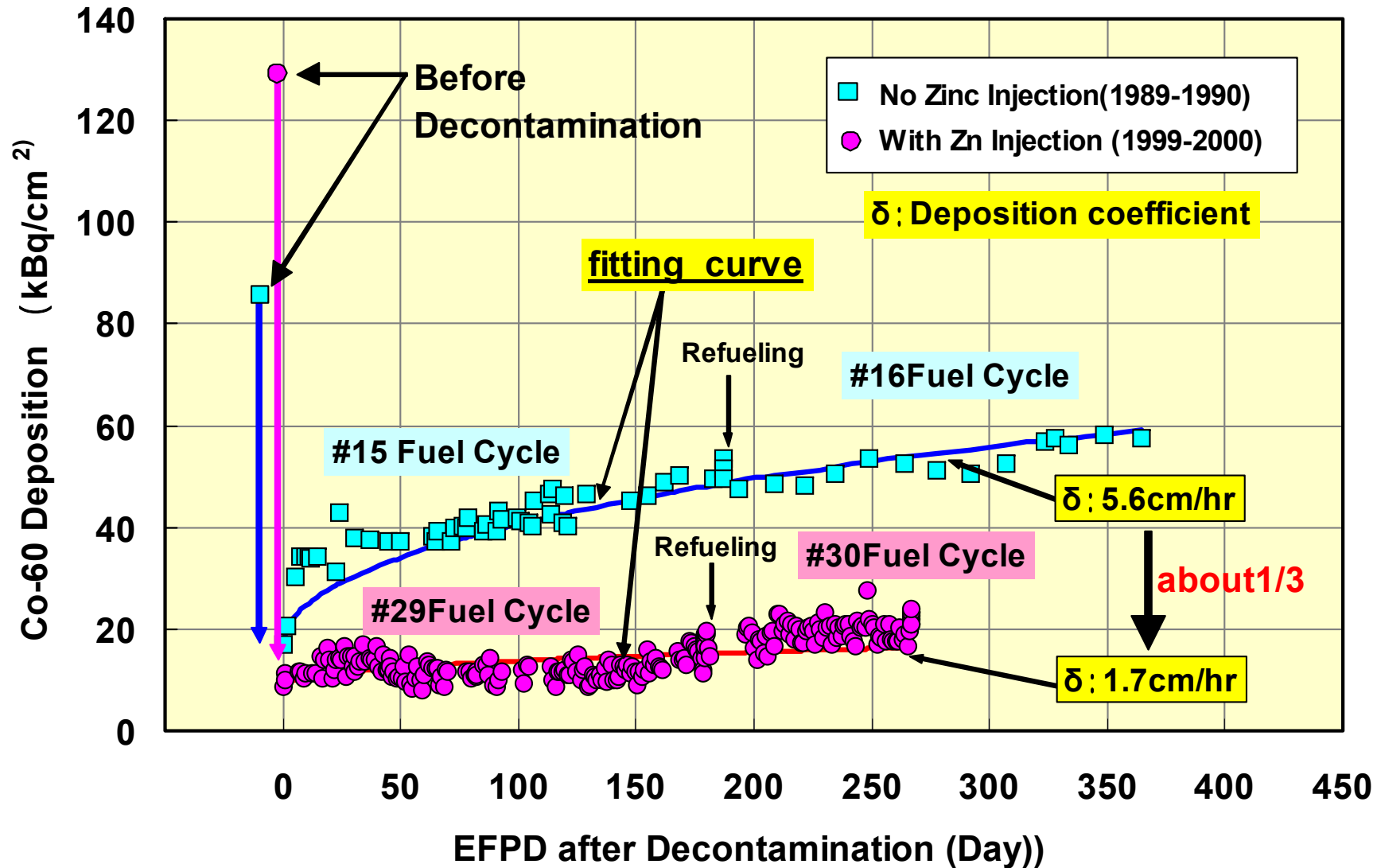
Long Term Trend of Co-60 Concentration in Reactor Water on HWC and Zinc Injection



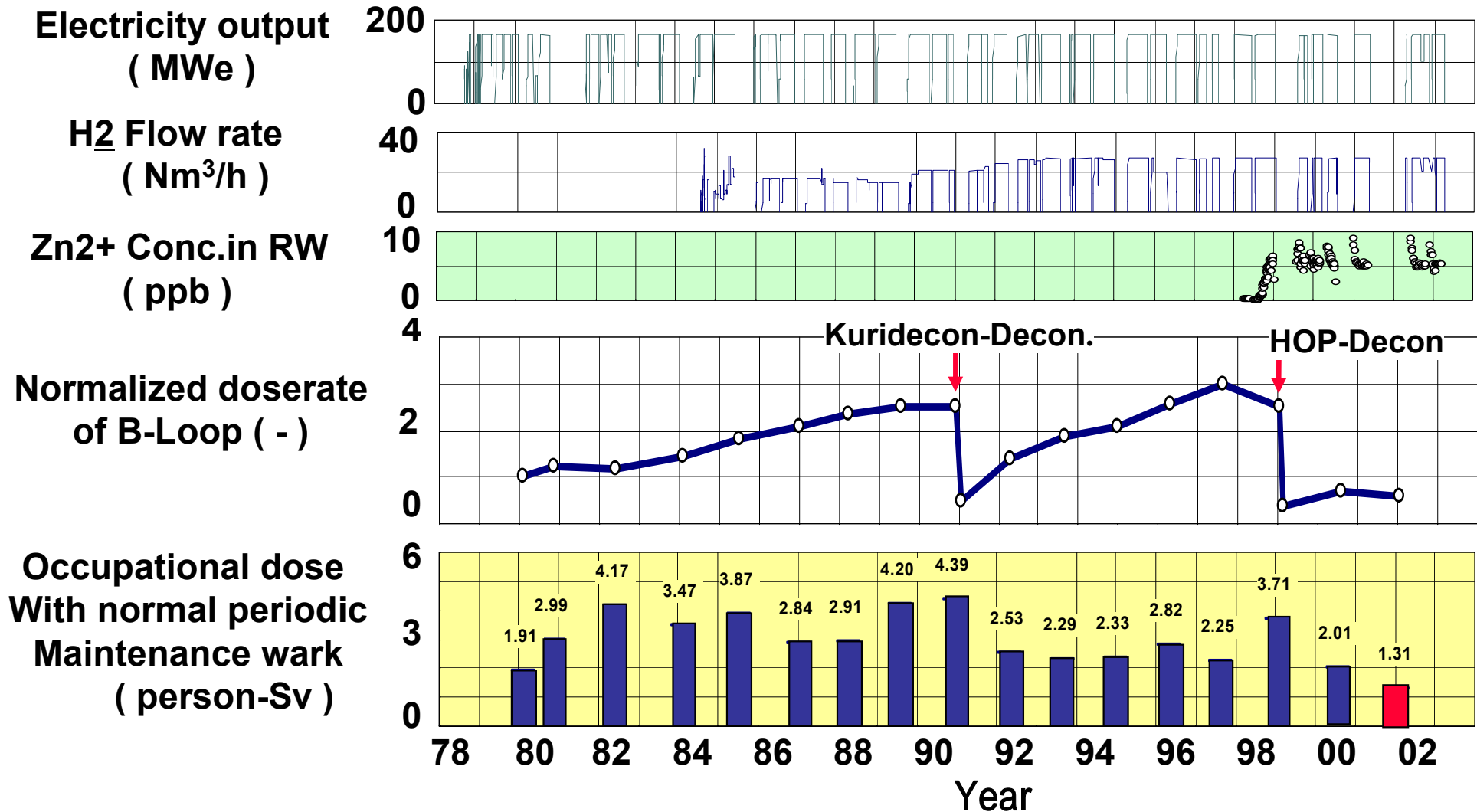
Ge Detector/shield Set Against RCP-D Outlet



After Decontamination Co-60 Deposition Coefficient



Long-term Occupational Dose Related Issues



RW* : Reactor water sampled from the inlet of purification bed

Normalized doserate** = $\frac{\text{Averaged doserate in a periodic maintenance period}}{\text{Averaged doserate in the 1st periodic maintenance period}}$

CONCLUSION

- ***The zinc injection after the decontamination effectively suppressed the re-adhesion of Co-60 on the surface of piping and maintained the radiation source state at a low-level .***
- ***The occupational exposure dose in 17th inspection period was at the minimum, 1.31 person ·Sv, through Fugen's operational period.***
- ***The dose control measures for a permanent, effective plant were achieved by these water chemistry control technique developments and in this way, effective exposure dose control measures were established.***