

IN-SERVICE INSPECTION PROVISIONS

- 12.1. Primary vessel and internals
- 12.1.1. Provision for routine ISI of inside of primary vessel and internal structure
 - USV - under-sodium viewing
 - UGV - under-gas viewing e.g. optical periscope
 - DM - displacement monitoring by ultrasonic detectors
- 12.1.2. Provision for routine ISI of outer surface of primary vessel
 - VI - visual inspection by optical equipment
 - EC - eddy current measurements
 - US - ultrasonic measurements
 - TV - tracked vehicle
 - FV - free-moving vehicle
 - AD - aerosol detection of primary vessel leak
 - Elcon - electrical contact

Experimental Fast Reactors

Plant	12.1.1.	12.1.2.
Rapsodie (France)	DM	
KNK-II (Germany)		
FBTR (India)		AD
PEC (Italy)	optical DM at vessel, mechanical DM of internals	
JOYO (Japan)	AD	
DFR (UK)		
BOR-60 (Russia)	AD	
EBR-II (USA)		
Fermi (USA)	internal-visual with optical aids (limited extent)	
FFTF (USA)		TV
BR-10 (Russia)		
CEFR (China)		AD, VI

Demonstration or Prototype Fast Reactors

Phénix (France)		
SNR-300 (Germany)		
PFBR (India)		AD,US,VI
MONJU (Japan)		AD,VI
PFR (UK)		
CRBRP (USA)		TV
BN-350 (Kazakhstan)	UGV	AD, Elcon
BN-600 (Russia)	UGV	AD, Elcon
ALMR (USA)		VI

Commercial Size Reactors

Super-Phénix 1 (France)	USV*,UGV*	Elcon/VI*,US*,FV*
Super-Phénix 2 (France)		
SNR 2 (Germany)		
DFBR (Japan)		
CDFR (UK)	ultrasonic detectors using tracked vehicles	
BN-1600 (Russia)	to be determined	AD, Elcon
BN-800 (Russia)	UGV	AD, Elcon
EFR	UGV,DM	VI,US,TV
ALMR (USA)		VI

* periodic inspection during shutdown

IN-SERVICE INSPECTION PROVISIONS

- 12.2. Primary circuit pipes
VI - visual inspection by optical equipment
EC - eddy current measurements
US - ultrasonic measurements
TV - tracked vehicle
FV - free-moving vehicle

Experimental Fast Reactors

Plant	12.2.
Rapsodie (France)	displacement monitoring of the vessel inlet and outlet
KNK-II (Germany)	
FBTR (India)	
PEC (Italy)	visual inspection of primary piping at reactor shutdown
JOYO (Japan)	sodium leakage monitoring, visual examination, ultrasonic test, displacement measurement, and test piece surveillance
DFR (UK)	visual (occasional entry)
BOR-60 (Russia)	leak detectors
EBR-II (USA)	
Fermi (USA)	
FFTF (USA)	periscopes for visual inspection of primary piping and valves
BR-10 (Russia)	sodium leak monitoring, visual examination
CEFR (China)	

Demonstration or Prototype Fast Reactors

Phénix (France)	
SNR-300 (Germany)	
PFBR (India)	
MONJU (Japan)	sodium leakage monitoring and visual and volumetric examinations
PFR (UK)	
CRBRP (USA)	camera mounted on arm to inspect piping and guard vessels
BN-350 (Kazakhstan)	leak detectors
BN-600 (Russia)	
ALMR (USA)	

Commercial Size Reactors

Super-Phénix 1 (France)	
Super-Phénix 2 (France)	
SNR 2 (Germany)	
DFBR (Japan)	sodium leakage monitoring and visual and volumetric examinations
CDFR (UK)	
BN-1600 (Russia)	
BN-800 (Russia)	
EFR	
ALMR (USA)	

IN-SERVICE INSPECTION PROVISIONS

- 12.3. Secondary circuit pipes
VI - visual inspection by optical equipment
EC - eddy current measurements
US - ultrasonic measurements
TV - tracked vehicle
FV - free-moving vehicle
LD - leak detectors (electrical contact)
SD - smoke detectors

Experimental Fast Reactors

Plant	12.3.
Rapsodie (France)	
KNK-II (Germany)	
FBTR (India)	
PEC (Italy)	manned access is permissible
JOYO (Japan)	LD and test piece surveillance
DFR (UK)	VI,LD
BOR-60 (Russia)	LD
EBR-II (USA)	periodic inspection, and as needed*
Fermi (USA)	
FFTF (USA)	manned access
BR-10 (Russia)	LD,VI
CEFR (China)	LD,SD

Demonstration or Prototype Fast Reactors

Phenix (France)	LD,SD
SNR-300 (Germany)	
PFBR (India)	LD
MONJU (Japan)	LD,VI
PFR (UK)	LD,SD
CRBRP (USA)	in-containment - as 12.2. ex-containment - manual techniques
BN-350 (Kazakhstan)	LD
BN-600 (Russia)	LD,SD
ALMR (USA)	LD,SD

Commercial Size Reactors

Super-Phenix 1 (France)	LD,VI,SD/US**, X-rays**
Super-Phenix 2 (France)	LD,VI
SNR 2 (Germany)	
DFBR (Japan)	LD,VI
CDFR (UK)	LD,SD
BN-1600 (Russia)	LD,SD
BN-800 (Russia)	LD,SD
EFR	VI,EC,US,LD
ALMR (USA)	LD,SD

* e.g., after October 1983 earthquake

** periodic inspection during shutdown

IN-SERVICE INSPECTION PROVISIONS

- 12.4. IHX
USV - under-sodium viewing
UGV - under-gas viewing e.g. optical periscope
DM - displacement monitoring by ultrasonic detectors
VI - visual inspection by optical equipment
EC - eddy current measurements
US - ultrasonic measurements
TV - tracked vehicle
FV - free-moving vehicle
LD - leak detection

Experimental Fast Reactors

Plant	12.4.
Rapsodie (France)	
KNK-II (Germany)	
FBTR (India)	
PEC (Italy)	
JOYO (Japan)	sodium leakage monitoring and test piece surveillance
DFR (UK)	
BOR-60 (Russia)	leak detectors, control Na level, Ar pressure
EBR-II (USA)	as needed
Fermi (USA)	tube bundles can be removed for inspection
FFTF (USA)	periscopes for visual inspection of primary piping and valves
BR-10 (Russia)	radioactive sodium leak monitoring
CEFR (China)	LD

Demonstration or Prototype Fast Reactors

Phenix (France)	sodium leakage monitoring
SNR-300 (Germany)	
PFBR (India)	sodium leakage monitoring
MONJU (Japan)	sodium leakage monitoring and visual examination
PFR (UK)	special flask and lifting equipment available
CRBRP (USA)	camera mounted on arm to inspect exterior and guard vessel
BN-350 (Kazakhstan)	leak detectors, control Na level, Ar pressure
BN-600 (Russia)	control Na level, Ar pressure
ALMR (USA)	

Commercial Size Reactors

Super-Phenix 1 (France)	LD
Super-Phenix 2 (France)	continuous monitoring of leaks
SNR 2 (Germany)	
DFBR (Japan)	
CDFR (UK)	
BN-1600 (Russia)	control Na level, Ar pressure
BN-800 (Russia)	control Na level, Ar pressure
EFR	LD
ALMR (USA)	

IN-SERVICE INSPECTION PROVISIONS

12.5. Steam generator units

- RVI - regular visual inspection of tube-bores and structures
- USV - under-sodium viewing
- UGV - under-gas viewing e.g. optical periscope
- DM - displacement monitoring by ultrasonic detectors
- VI - visual inspection by optical equipment
- EC - eddy current measurements
- US - ultrasonic measurements
- TV - tracked vehicle
- FV - free-moving vehicle
- LD - leak detection

Experimental Fast Reactors

Plant	12.5.
Rapsodie (France)	
KNK-II (Germany)	
FBTR (India)	continuous monitoring of leaks
PEC (Italy)	
JOYO (Japan)	
DFR (UK)	none
BOR-60 (Russia)	leak detectors, control of Na level and Ar pressure, RVI
EBR-II (USA)	periodic and as needed
Fermi (USA)	RVI, tube sheet is accessible
FFTF (USA)	
BR-10 (Russia)	no steam generator
CEFR (China)	RVI,US,LD

Demonstration or Prototype Fast Reactors

Phénix (France)	LD
SNR-300 (Germany)	
PFBR (India)	continuous monitoring of leaks eddy current testing
MONJU (Japan)	sodium leakage monitoring and visual and volumetric examinations
PFR (UK)	LD
CRBRP (USA)	exterior-manual techniques tubing-ultrasonic probes
BN-350 (Kazakhstan)	leak detectors, control of Na level, Ar pressure, RVI
BN-600 (Russia)	leak detectors, control of Na level, Ar pressure, RVI
ALMR (USA)	

Commercial Size Reactors

Super-Phénix 1 (France)	LD/US*,RUI*
Super-Phénix 2 (France)	accessibility to each tube
SNR 2 (Germany)	
DFBR (Japan)	LD
CDFR (UK)	hydrogen detectors
BN-1600 (Russia)	leak detectors, control of Na level, Ar pressure, RVI
BN-800 (Russia)	leak detectors, control of Na level, Ar pressure, RVI
EFR	RVI,US,LD
ALMR (USA)	

* periodic inspection during shutdown