



**JV "INFORMATION AND TECHNOLOGIES" (KIEV, UKRAINE)**

**INIT**

**PROJECT 1 - IN-CORE MONITORING SYSTEM (ICMS)**

**PROJECT 2 – NEUTRON FLUX MONITORING EQUIPMENT SUBSYSTEM (NFME)**

## **IN-CORE MONITORING SYSTEM (ICMS)**

- Russian Scientific Center (RSC) “Kurchatov Institute” in 1970-1972 years for the VVER-1000 reactors developed in-core monitoring system (ICMS).
- The existing ICMS exhaust their lifetime and now don't satisfy modern requirements in the area of its reaction to events, quality and reliability.
- Now RSC “Kurchatov Institute” (Moscow, Russia), PA “Impulse” (Severo-Donetsk, Ukraine) and Ukraine-American JV “Information and Technologies” INIT (Kiev, Ukraine) developed the modern ICMS to replace its on the Ukrainian NPP's.
- INIT is authorized to represent this theme at this work shop.

## **STRUCTURE of ICMS**

consists of:

- in-core neutron flux probes – Rh detectors (64 measuring probes x 7 self power neutron detectors (SPND) = 448 SPND);
- temperature detectors – XA thermocouples of special design for thermal monitoring on the output of fuel assembly and platinum thermometers of resistance for measuring the coolant temperature on the circulation loops;
- measuring equipment for measuring, analogue-digital conversions and transfer signals of neutron flux detectors, detectors of location of the control rod of control and protection systems, concentration of the boron acid, and also the detectors of in-core thermal balance;
- the computer system for physical, thermal and hydraulic calculations of the in-core state in the real time.

## **ICMS FUNCTIONS AND TASKS:**

- implementation the methods of operational diagnostics of reactor in-core, neutron-noise and vibration-acoustic analysis;
- implementation of all necessary neutronic and physics calculations of a current conditions in in-core utilizing sensors data in real time;
- protection of a in-core from local overheating;
- informational support to optimize thermal power control in transient conditions;
- support in emergency situations where symptom based emergency operating instructions (SOI's) are being used to control these situations.

## **ECONOMIC**

- For Ukraine:

The schedule of ICMS replacing on the Ukrainian NPP's:

1998<sup>th</sup> year – 1 Unit,  
1999<sup>th</sup> year – 2 Units,  
2000<sup>th</sup> year – 2 Units,  
2001<sup>th</sup> year – 2 Units.

The estimated cost of 1 separate replacing \$4,500,000.00.

- For USA:

joint development of ICMS for the PWR reactors.

# NEUTRON FLUX MONITORING EQUIPMENT SUBSYSTEM (NFME)

## **PURPOSES**

1. Monitoring the relative change of the reactor power.
2. Monitoring the speed (period) of the changes of the reactor power.
3. Emergency commands generation.
4. Monitoring the state of the in-core at the refueling of the reactor.

# NEUTRON FLUX MONITORING EQUIPMENT SUBSYSTEM

## **COMPONENTS OF NFME**

1. Ex-core neutron flux monitoring detectors.
2. High-sensitivity converters.
3. Hardware-and-software complex for signal processing and emergency command generation.
4. Neutron flux measurement correction devices.
5. Ex-core refueling monitoring devices.
6. Devices for detection of appearance of steam-gas mixture in the reactor at the operation.
7. Devices for diagnostics of the state of reactor internals.
8. Displays and recorders.

## NEUTRON FLUX MONITORING EQUIPMENT SUBSYSTEM

NFME functions specified in Ukrainian standard and directive documents

№	Functions	Manufacturer		
		IMPULS	SNIIP	SIEMENS
1	Neutron flux monitoring: - detectors - converters - hardware-and-software complex for signal processing and emergency command generation	yes yes yes	yes yes yes	yes yes yes
2	Neutron flux measurement correction devices	yes	no	no
3	Ex-core refueling monitoring devices	yes	yes	yes
4	Devices for detection of appearance of steam-gas mixture in the reactor at the operation	yes	no	no
5	Devices for diagnostics of the state of reactor internals	yes	no	no
	Life time	30 years	10 years	30 years
	Manufacture's guarantee period	2 years	1 year	2 years
	Spare parts supplied for	15 years		15 years

## NEUTRON FLUX MONITORING EQUIPMENT SUBSYSTEM

### **OPPORTUNITIES**

1. Our companies INIT and PA "IMPULSE" (Severo-Donetsk, Ukraine) offer to organize the enterprise to manufacture the NFME on the production facilities of the IMPULSE which used for manufacture of the adequate systems.
2. The IMPULSE company has test grounds and experience in manufacture of equipment meeting requirements of the Ukrainian nuclear regulation administration.
3. An agreement with SNIIP (Russia) has been reached on its participation in the updating of the NFME and transfer to us the NFME fabrication technology.
4. It is contemplated to update and manufacture the NFME with the use of complementary items made by USA manufactures.
5. Full preparation for manufacture of NFME - \$3 million and 1.5 years.
6. Demand - 8 sets of NFME in 2001-2005 years in Ukraine.
7. A successful beginning of commercial production of the NFME will open the Russian NPP market.

## NEUTRON FLUX MONITORING EQUIPMENT SUBSYSTEM

### COMPONENTS OF NFME

1. Ex-core neutron flux monitoring detectors.
2. High-sensitivity converters.
3. Hardware-and-software complex for signal processing and emergency command generation.
4. Neutron flux measurement correction devices.
5. Ex-core refueling monitoring devices.
6. Devices for detection of appearance of steam-gas mixture in the reactor at the operation.
7. Devices for diagnostics of the state of reactor internals.
8. Displays and recorders.