

SPECIALIZED GAMMA-RAY FLAW DETECTOR «DAR - Se75 FN R » WITH RADIATION SOURCE Se-75

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This work was carried out under the Program for the production of heat-exchange equipment for the FN800 reactor under construction and the full realization of the requirements of the Federal Rules "Equipment and pipelines of nuclear power plants. Welded joints and surfacing. Control Rules RRNEG - 7 - 010 - 89 "in relation to radiographic examination of welded joints" pipe - pipe board "heat exchangers of the reactor FN800.

Aim was to increase the sensitivity of the method in two-fold compared with currently used equipment with a source of iridium - 192.

In the process of implementation of works created gamma-defectoscope "DAR- Se75 BN R" for a panoramic raying welds, heat exchangers under serial acute focal source of selenium - 75 activity to 5Ki Øwith the size of the active part 1,0 x 1,0 mm, manufactured by JSC "SSC Nuclear Reactors ", Dimitrovgrad.

Gamma - defectoscope "DAR - Se75FN R" meets the following regulatory documents governing the requirements for safety, design and ecology in the design, manufacture and operation of gamma - flaw: .

1. GOST 23764 - 79 " Gamma - defectoscope. IS.

2. Sanitary rules SP2.6.1.1284 - 03 "Radiation Safety in radionuclide flow".
3. OSPORB - 99 "Basic sanitary rules for radiation safety.
4. NRB - 99/2009 "Radiation Safety Standards".
5. GOST 16327 - 88 - "Complete packaging for the transport of radioactive substances".
6. ISO 3999 - 2000 "Apparatus for radiographic TU".
7. IAEA, Vienna, 1996 "Regulation on the transport of radioactive substances".
8. NP-053-04 "Safety in the Transportation of Radioactive Material

Photo prototype gamma defectoscope is shown in Figure 1.

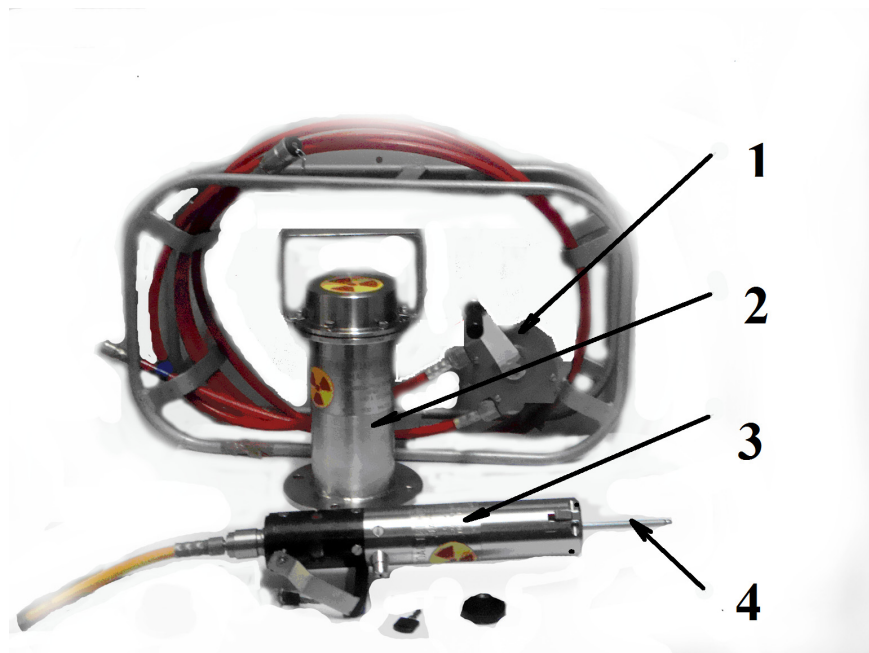


Fig.1 Gamma - defectoscope "DAR - Se75 FN R" (nominated by the holder of the source).

1. Drive 2. Container 3 - channel 3. Head radiation 4. Holder

Object of control - heat exchanger is schematically shown in Figure 2.

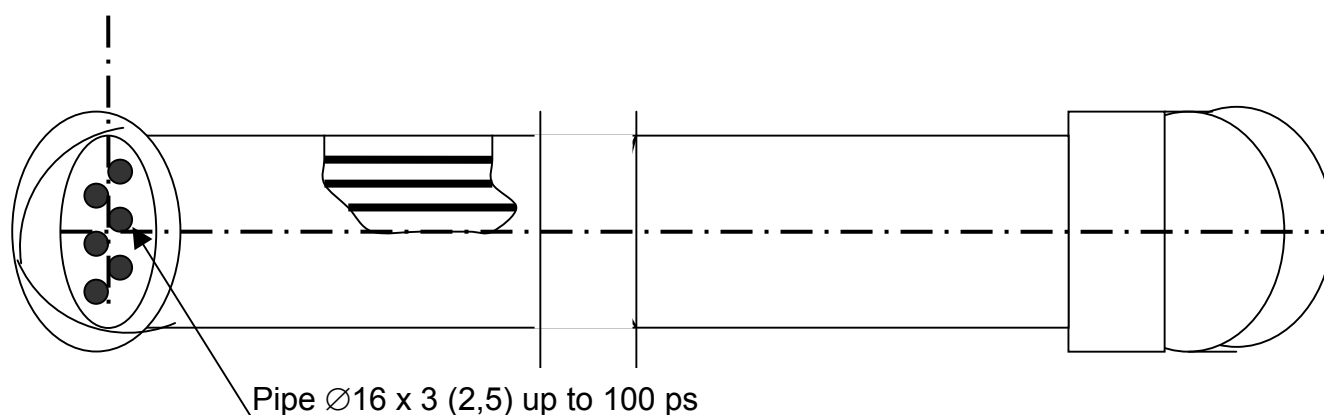


Fig.2 Heat exchanger.

Pipes welded in the tube plate thickness up to 100mm. Site welding is shown schematically in Figure 3.

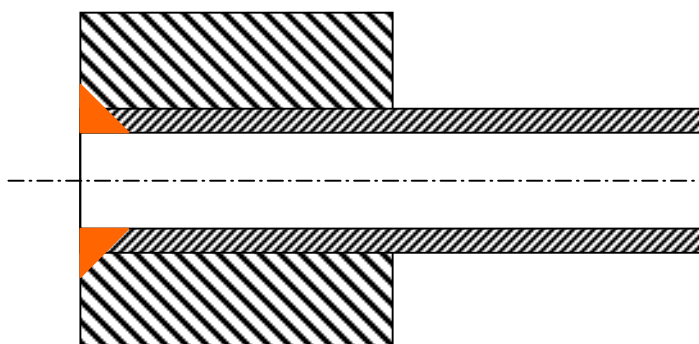


Fig.3 Node weld tube plate with the pipe Ø 16 x 3 (2,5) heat exchanger .

Development of gamma - ray flaw detectors for the panoramic weld "pipe - tube plate" heat exchangers on the basis of radionuclide iridium - 192 and ytterbium -169 was conducted in the USSR «USRIRT» All-Union Scientific Research Institute for Radiation Technology (apparatus DAR - 3), and iridium - 192 in Germany by Sauerwein (apparatus B3) 1975 - 1976gg. Schematic diagram of the panoramic raying the weld is shown in Figure 4.

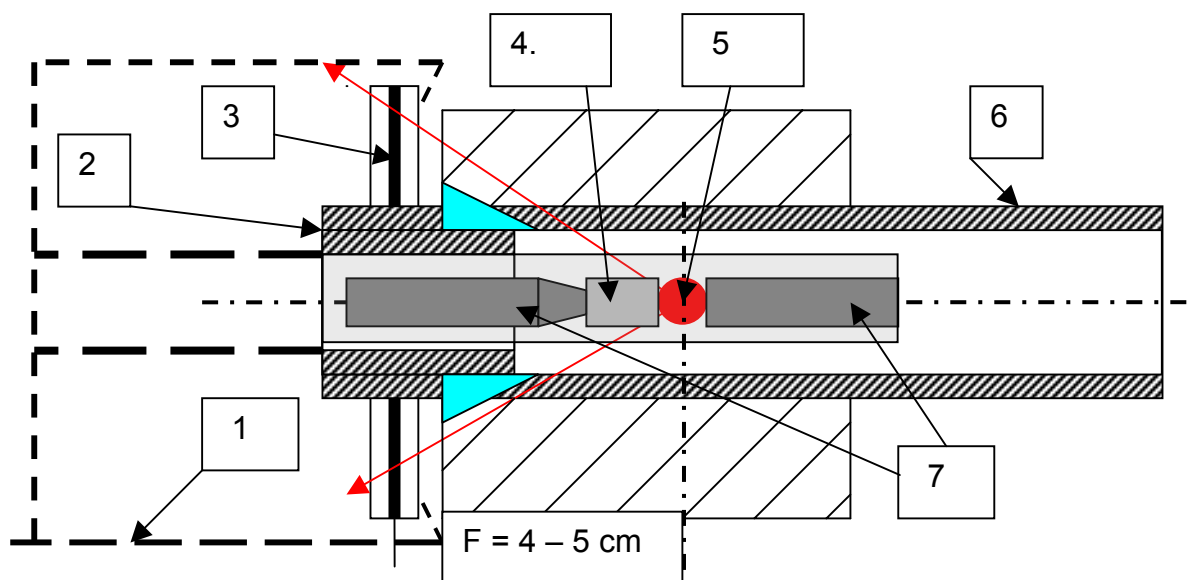


Fig.4 Scheme of the panoramic raying welds "tube - tube plate".

- 1. The Head radiation 2. Compensator 3. Special cassette 4. Plastmassovy liner 5. Source gamma - radiation 6. Pipe 7. Blocks of protection ..**

**Sources of Gamma - radiation is used to control weld
pipe boards are shown in Table 1.**

Table 1 Sources of gamma - radiation

№	Sources		T _{1/2}	Eγ ef. MtV	Sources ,mm				Activit y Ku	Manufac turer
					External capsule		Active part			
					D	L	d	l		
1	Iridium-192	Ir ¹⁹²	74 days	~0,40	4,0	5,0	1,0	1,0	4÷5	FSUE PA «MAYA K»
2	Ytterbium -169	Yb ¹⁶⁹	30 days	~0,08	4,0	5,0	0,5	0,5	3,0	JSC “State Scientific Center Re- search Institute of Atomic Reac- tors”
3*	Selenium-75	Se ⁷⁵	124 days	~0,200	6,0 ^{+0,5}	12,0 ^{+0,5}	1,0	1,0	5,0	JSC “State Scientific Center Re- search Institute of Atomic Reac- tors”

* Acute focal sources selenium - 75 utilized in the production of high specific activity of $\approx 1200 \text{ Ki g}$.

The sensitivity of radiographic control in half (from 04 mm to 0.2 mm) compared with Ir 192 source with a possible reduction in the energy spectrum - the radiation source and the size of the focal spot. The use of ytterbium - 169 of - for the small half-life $T_{1/2}$ in-line production is not acceptable and useful in research. Source on the basis of selenium - 75 has the following advantages compared to Ir 192: energy gamma radiation is less than 2 times, and half-life greater than that of Ir 192 in 1,6 times. That gives rise to the use of Se75 to the task.

The experimental work on radiographic examination of welded joints "pipe - tube plate" heat exchangers FN800 reactor prototype gamma - flaw "DAR Se75FN" sources selenium -75 (OJSC SSC NIIR ") does not yield the expected results.

This is due to the fact that the source Se75 did not meet the technical requirements.

Spectral analysis of radiation sources and digital image processing of the active part of the source showed that the serial Acute focal sources of selenium -75 with the size of $\varnothing 1 \times 1$ mm primary capsule of vanadium did not have a fixed size of the active part, and the use of primary titanium capsule additionally contain in the emission spectrum of the source of "hard" line of 0.8 - 1.0 MeV.

The calculation of the protection of gamma-flaw detector was carried out on the spectrum of Se75, which has no hard lines, the appearance in the spectrum of the source lines 0,8-1 MeV led to a reduction of the protection device.

Strict requirements to the parameters of the radiation source Selenium - 75 are needed to provide the required sensitivity of the control of welding pipe-pipe board FN800 reactor in limited quantities focal length ($F = 4,0 - 5,0$ cm) and require the "purity" of the emission spectrum characteristic of Selenium - 75, rather than the primary material for the capsule. Steps are being taken to address the deficiencies identified sources based on selenium - 75 and its manufacture, as part of a tool for controlling weld "pipe - tube plate" heat exchangers of the reactor FN800.

We have shown that the source of Se75 production has flaws that are discovered in the setting of targets with high requirements to the sensitivity of radiographic control.