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DOSE LEVEL MEASUREMENTS DURING STARTUP OF THE SECOND UNIT OF THE PAKS NUCLEAR POWER PLANT

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In September 1983 at the Regional Conference of IRPA results were presented which we obtained during startup of the first unit of the PNPP relating to the dose levels in the controlled area.
This activity has been extended during the startup of the second unit and as a result we have the dose level values for this unit too.
In connection with this work:
a) the experimental techniques were only slightly modified
b) the computer program called PAVDAP was used for evaluation, extrapolation and storing of the data.
We present here the most important modifications as well as some characteristic measured data obtained during startup of the second unit. Finally we compare the dose level values obtained for the same areas in the first and the second unit of the PNPP.

Introduction

It is planned that by 1995 eight blocks of a WWER-440 type Soviet nuclear power reactor will operate along the DANUBE river near the town of Paks, Hungary. At present two such power reactors are working and two others are under construction.

The startup work of the second block of PNPP was carried out in 1984 and in the measurements of the dose levels the co-workers of the Training Reactor of the Budapest Technical University also participated. The experimental methods as well as the computerized data processing of the experimental data used at the startup of the first block were reported in our previous paper [1]. The radiation shield testing program of the second block has been elaborated based on experience and it has the following main objectives:

a) the shield should satisfy the design criteria and be adequate to protect personnel throughout the whole life of the nuclear power plant;
b) the dose equivalent rate values obtained during testing should be able to be used later for estimating radiation exposure during the reactor operation.

In the following we would like to introduce briefly the shield test program and provide some of the characteristic measured data which at the same time make possible a comparison with the data obtained from the first block [1]. Finally we summarize the most important measurement experiences during startup of the second block.

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The shield test program of the second block

This work consists of three main steps:

a) The selection of locations of the so-called dose base points in all rooms of the controlled area of the second block. Every such point has been marked by one painted identification symbol.

b) Measuring of the gamma and neutron dose levels during the startup of the second block.

c) Computerized processing of the results using the PAVDAP computer code.

The marking of the dose base points took place in the last phase of the construction and during this procedure one or more symbols was painted in each room of the controlled area where the dose level measurements were carried out during the startup at different power levels.

The measuring instruments used at startup were the same ones as used at the first block [1].

The computer code PAVDAP has been written in FORTRAN IV language for an R-55 type computer and its main functions are listed below:

a) Conversion: to convert the measured data into SI units.

b) Storage: to store the measured data at the dose base points for later use.

c) Extrapolation: the program extrapolates each data measured at different power levels to the nominal 100 % power (that is 1375 MWth).

d) Documentation: compilation of the measured data in an easy-to-survey form.

Some characteristic measured results

In Table I we present the data of the dose level measurements at some crucial places of the reactor building.

Conclusions

Comparing the data of the Table I with those referring to the first block (see Table I of [1]) the following can be concluded:

a) The dose equivalent rate values measured in the rooms under the reactor vessels coincide in the case of both blocks.

b) The deviation of measured data referring to the hermetic box of the steam generators and to the room of electric motors of the main primary circuit pumps is rather high. This effect may be due to the 60 - 70°C ambient temperature and the near 100 % relative humidity at the places of interest. Some measuring instruments cannot work properly in such conditions.

c) Though it is not listed in Table I it can be seen from the detailed documentation that dose levels in the common reactor hall of the first and second block differ only slightly from the natural background, i.e. the top shielding of the reactors is excellent.

Table I

Neutron and Gamma dose equivalent rate values ($\dot{D}_n$ and $\dot{D}_\gamma$) at some crucial places of the second block of the PNPP (measured values are extrapolated to the nominal 100 % reactor power, 1375 MWth)

Dose Base Point Code	Room		$\dot{D}_n$ mSv/h	$\dot{D}_\gamma$ mSv/h	$\frac{\dot{D}_n}{\dot{D}_n+\dot{D}_\gamma}$ .100 %
21050	Control room of reactor vessel		7.68×10^{1}	2.92×10^{1}	72.5
25910	Box of steam gene-	1st loop	3.62×10^{2}	5.14×10^{2}	41.3
25920	rators (1 m before	2nd loop	1.54×10^{2}	3.62×10^{2}	29.8
25930	the primary tube	3rd loop	5.40×10^{2}	5.93×10^{2}	47.6
25940	connections)	4th loop	4.51×10^{2}	4.69×10^{2}	49.0
25950		5th loop	1.55×10^{2}	4.59×10^{2}	25.3
25960		6th loop	2.99×10^{2}	3.57×10^{2}	45.6
26011	Room of electric	1st loop	1.96×10^{-2}	4.84×10^{-2}	28.8
26012	motors of the main	2nd loop	1.15×10^{-2}	4.40×10^{-2}	20.7
26013	circulating pumps	3rd loop	1.36×10^{-2}	5.50×10^{-2}	19.1
26014		4th loop	1.46×10^{-2}	4.18×10^{-2}	25.9
26015		5th loop	1.67×10^{-2}	3.74×10^{-2}	30.9
26016		6th loop	1.25×10^{-2}	3.52×10^{-2}	26.2

Summarizing it can be stated that the program for testing radiation shields and the computer code PAVDAP discussed above can be utilized for the future startups of the later blocks of the PNPP with good success. For higher accuracy the investigation of the behaviour of the measuring instruments at elevated temperature seems to be necessary.

References

1. S. Fehér, M.F. Nagy, J. Rónaky, G. Rósa and E. Virágh, Dose Level Measurements during Startup of the First Unit of the Paks Nuclear Power Plant, Proc. XI. Regional Congress of IRPA, Vienna, Austria, 1983, Vol.2, pp. 216-220.