Experiences with electronic personal dosimeters at Dukovany Nuclear Power Plant-Czech Republic.

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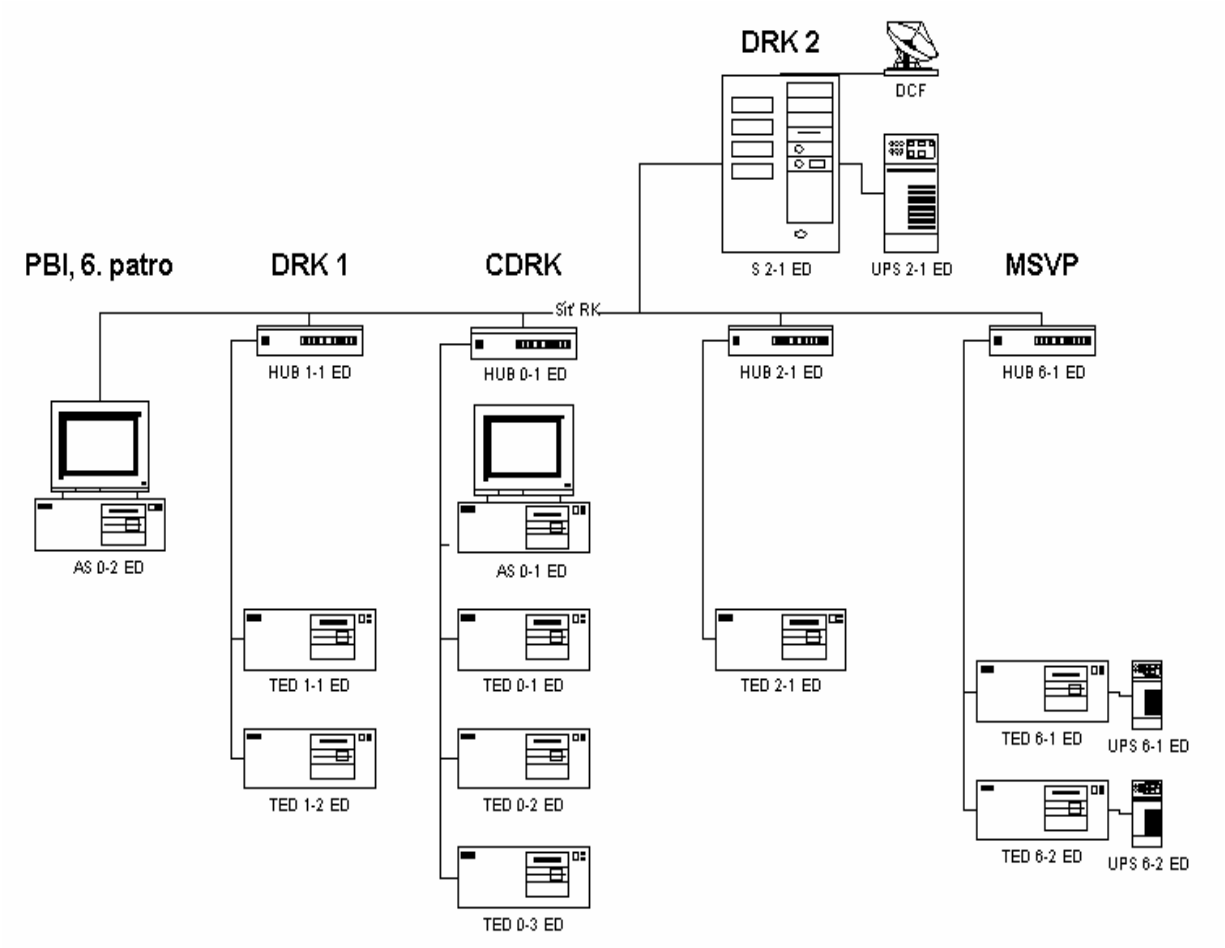
The Dukovany Nuclear Power Plant operates four WWER-440 type reactors. Unit 1 has been operating since 1985, Unit 2 and Unit 3 since 1986, Unit 4 was connected to the grid in 1987.

At Dukovany NPP occupational dosimetry is performed by approved Personal Dosimetry Service. The basic facilities for measuring external exposure are film badge (legal dosimeter), electronic personal dosimeter (EPD) and radiophotoluminescent dosimeter (RPL) as operational dosimeter, TLD for measuring doses to the extremities and TLD albedo dosimeter as neutron dosimeter.

The presentation is based on the experiences with electronic personal dosimeters gathered at Dukovany NPP for the last three years. Electronic Personal Dosimetry System (EPDS) was devoloping by Czech company VF, a.s. and from 2002 year is also used at Temelin NPP (Czech Republic), SE VYZ Bohunice (Slovakia) and SE Mochovce NPP (Slovakia) as well. EPDS is designed for Merlin Gerin, Siemens and RADOS electronic dosimeters.

Description of EPDS at Dukovany NPP:

- Electronic Personal Dosimeter (EPD) – DM 90, DMC 90, DMC 2000XB, DMC 2000S Merlin Gerin, (together 1000 pieces)
- Physical layer (HW) – 10 pieces of date terminals, 3 pieces of personal computers and server interconneted by LAN
- Logical layer (SW) – database ORACLE, SW controlling the process of input and output in/from controlled area, application SW for management of EPDS and data analysis



Picture 1:Chart of disposal EPDS at Dukovany NPP

Input to controlled area- the worker comming into the controlled area takes out EPD from the stack and enters it on the data station by using his identity card. Everybody has to enter the code of device, the code of work task and the number of radiation work permit if it is necessary before his entrance to controlled area. It is possible to choose the codes on the touch screen of data terminal. List of codes contains 50 codes for devices and 62 codes for work tasks in controlled area.

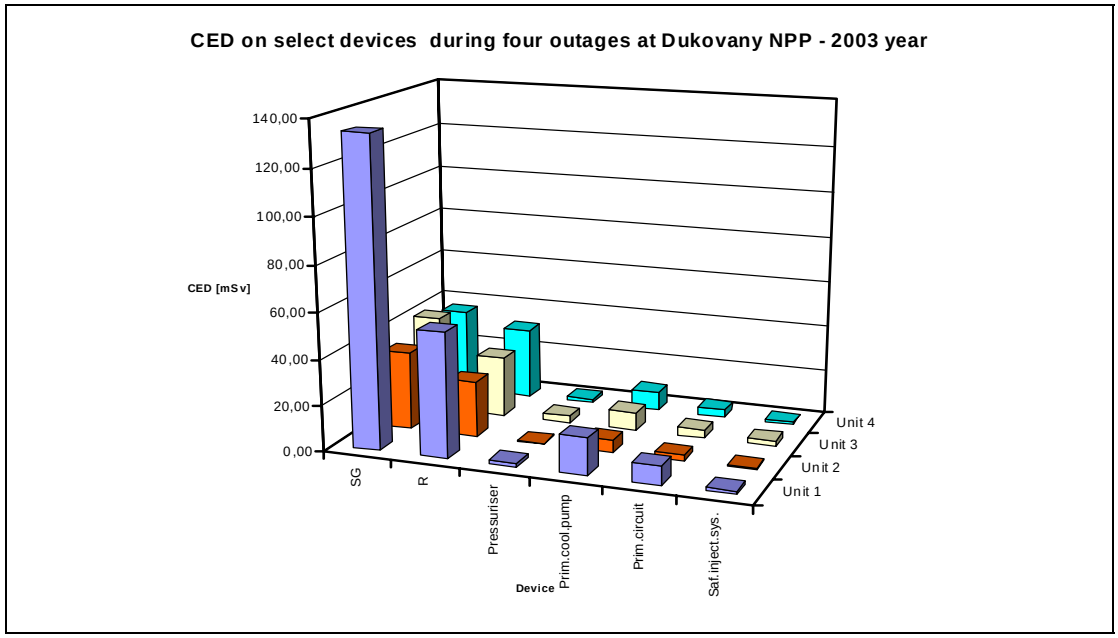
Output from controlled area- the worker has to check out EPD on the data station at the each exit from controlled area. He obtains the information about his personal dose and the information about his annual dose from beginning of the year on the screen of terminal.

Picture 2: Arrangement of data stations of Electronic Personal Dosimetry System

Picture 3: Data station of Electronic Personal Dosimetry System – input to controlled area

Results:

Electronic Personal Dosimeter is used for operative measuring of external radiation exposure of personnel at controlled area of Dukovany NPP. EPD is suitable instrument for this object, that works reliably.
Application SW for data analysis is used for daily monitoring of personal doses and for evaluation of collective doses during outages. System gives information about collective doses on devices and collective doses for select work tasks during outages. In addition EPDS allows the calculation of dose indexes $I_{D.}$ (I_D is the ratio of the relevant collective dose and the number of equivalent working hours). This information is applicable for planning doses on special working activities for next outages and allows a detection radiation sources also.



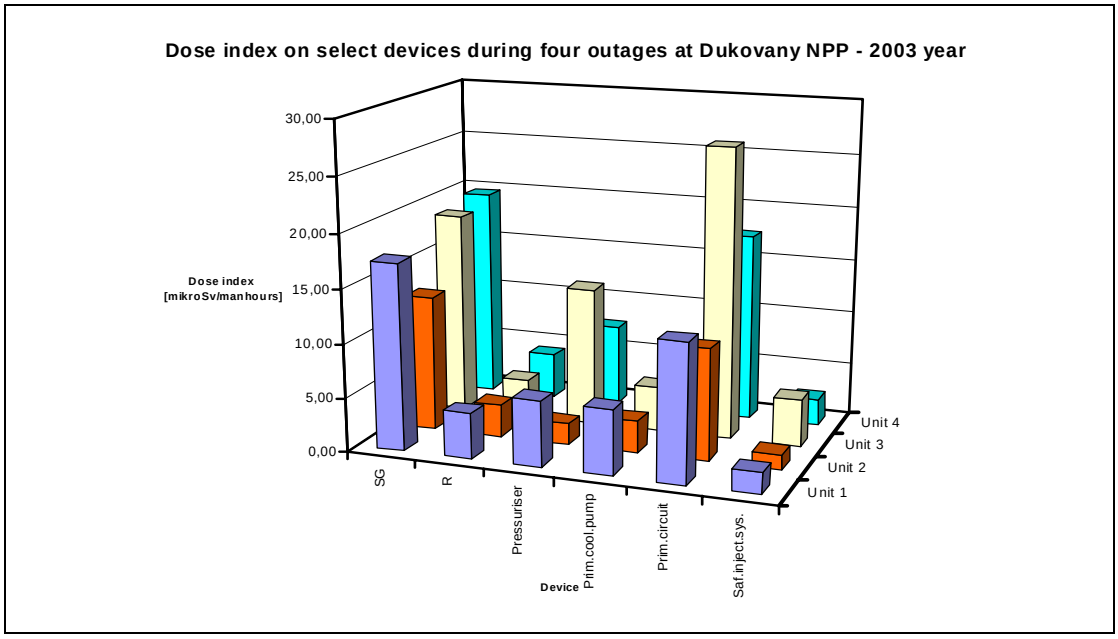


Table 1: Collective effective doses (CED) and average personal effective doses (Average IED) on select devices during four outages at Dukovany NPP in 2002 year

Unit	1			2			3			4		
Device	CED [mSv]	Number of person	Average IED [mSv]	CED [mSv]	Number of person	Average IED [mSv]	CED [mSv]	Number of person	Average IED [mSv]	CED [mSv]	Number of person	Average IED [mSv]
Steamgenerator	44,45	82	0,54	45,17	105	0,43	61,54	106	0,58	88,14	105	0,84
Reactor	29,38	118	0,25	19,41	102	0,19	31,04	110	0,28	80,41	169	0,48
Pressuriser	1,36	4	0,34	2,99	6	0,5	2,01	6	0,34	0,9	3	0,3
Primary coolant pump	10,7	43	0,25	6,75	44	0,15	8,06	40	0,2	13,62	26	0,52
Primary circuit	5,23	15	0,35	3,26	18	0,18	6,93	12	0,58	15,23	15	1,02
Safety injection system	1,48	18	0,08	3,07	22	0,14	1,72	19	0,11	1,52	15	0,1

Table 2: Number of hours ($\sum$ man-hours) and dose indexes (I_D) on select devices during four outages at Dukovany NPP in 2002 year

Unit	1		2		3		4	
Device	$\sum$man-hours	ID [µSv/manhours]	$\sum$man-hours	ID [µSv/manhours]	$\sum$man-hours	ID [µSv/manhours]	$\sum$man-hours	ID [µSv/manhours]
Steamgenerator	2604	17,07	4660	9,69	4021	15,3	5778	15,25
Reactor	12382	2,37	15932	1,22	14464	2,15	30624	2,63
Pressuriser	177	7,68	327	9,14	247	8,14	321	2,8
Primary coolant pump	1768	6,05	2655	2,54	1913	4,21	2640	5,16
Primary circuit	223	23,45	247	13,2	277	25,02	917	16,61
Safety injection system	881	1,66	1258	2,44	1007	1,71	1048	1,45

$$I_D = \frac{CED}{\sum man - hours} \quad [\mu Sv/man\text{-}hours]$$

Table 3: Collective effective doses (CED) and average personal effective doses (Average IED) on select devices during four outages at Dukovany NPP in 2003 year

Unit	1			2			3			4		
Device	CED [mSv]	Number of person	Average IED [mSv]	CED [mSv]	Number of person	Average IED [mSv]	CED [mSv]	Number of person	Average IED [mSv]	CED [mSv]	Number of person	Average IED [mSv]
Steamgenerator	133,98	105	1,28	34,05	80	0,43	41,51	74	0,56	36,78	67	0,55
Reactor	54,26	128	0,42	24,25	133	0,18	26,51	109	0,24	30,99	105	0,3
Pressuriser	1,91	3	0,64	0,42	6	0,07	3,07	5	0,61	1,55	4	0,39
Primary coolant pump	16,3	38	0,43	5,53	43	0,13	8,09	43	0,19	8,29	39	0,21
Primary circuit	8,03	9	0,89	2,53	11	0,23	3,69	10	0,37	3,45	14	0,25
Safety injection system	1,51	12	0,13	0,66	14	0,05	2,34	15	0,16	1,05	12	0,09

Table 4: Number of hours ($\sum$ man-hours) and dose indexes (I_D) on select devices during four outages at Dukovany NPP in 2003 year

Unit	1		2		3		4	
Device	$\sum$man-hours	ID [µSv/manhours]	$\sum$man-hours	ID [µSv/manhours]	$\sum$man-hours	ID [µSv/manhours]	$\sum$man-hours	ID [µSv/manhours]
Steamgenerator	7737	17,32	2701	12,61	2207	18,81	1872	19,65
Reactor	12761	4,25	8029	3,02	7636	3,47	7340	4,22
Pressuriser	310	6,15	210	1,98	238	12,88	204	7,6
Primary coolant pump	2690	6,06	1841	3	1936	4,18	2332	3,56
Primary circuit	631	12,73	245	10,34	137	26,96	197	17,52
Safety injection system	761	1,98	474	1,38	530	4,42	423	2,49

$$I_D = \frac{CED}{\sum man - hours} \quad [\mu Sv/man\text{-}hours]$$