PERSONNEL DOSE CONTROL COMPUTER BASED SYSTEM

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1. GENERAL PROVISIONS

The Personnel Dose Control Computer Based System (PDC CBS) of concern "Energoatom[1]" was developed to achieve correspondence to the requirement of the Federal Law "Population radiation Safety" and on the basis of the Russian Federation Government Enactment Num. 718 from 1997-06-16 "About the procedure of development of the united national system of citizens' individual exposure doses monitoring and registration".

PDC CBS provides the management of NPP stuff individual and collective doses in accordance with the ALARA principle.

PDC CBS was developed as the distributed system which consists of ten local subsystems (at every Russian plant) - NPP level and one common corporative centre - headquarters level.

This system was performed for all types of Russian NPPs and can be treated as the national analogue of ISOE and MADRAS.

2. MAIN GOALS AND TASKS OF PDC CBS

There are the main goals of PDC CBS development and implementation:

2.1. Monitoring and registration of the plant personnel and contractors individual doses;
2.2. Analysis and planning of the personnel radiation exposures during radiation - dangerous works;
2.3. Occupational exposure management on the basis of ALARA principle;
2.4. Control of execution of radiation protection regulations and standards;
2.5. Providing an information for development of the actions directed at radiation exposures forecast and decrease;
2.6. Information exchange on specific aspects of the dose management and good practice between all Russian plants.

To achieve these goals PDC CBS should provide:

- Organization of the local PDC CBS at every plant to collect external and internal doses information;
- Data safe keeping and confidentiality;
- Data transfer to ROSATOM[2] dose register.

3. PDC CBS ORGANIZATIONAL STRUCTURE

PDC CBS is divided between two levels:

- Plant level;
- Headquarters level.

[1] Since September 2008, Federal Unitary Corporation "Concern ROSENERGOATOM" has been reorganized to Corporation "Concern ENERGOATOM".
[2] Russian Federal Corporation

PDC CBS main goals at the plant level are:

- Monitoring and registration of the external individual doses - for routine, on-line and accidental control;
- Monitoring and registration of individual information about the content of incorporated radionuclides and the calculation of effective internal exposure dose;
- Analysis and planning of the plant personnel and contractors collective doses;
- Forming of special reports for providing the information.

PDC CBS main goals at the headquarters level are:

- Coordination of PDC CBS at the plat level;
- Analysis of the plant dose data;
- Provision of the plant dose data comparability on the basis of the special uniform classifiers and data base directories.

Information exchange between these two levels is provided on the basis of special information channels – Concern "Energoatom" Crisis Center Data Transmission System.

Responsibility for PDC CBS operation:

- On the plant level – Plant Chief Engineer;
- On Headquarters Level – Head of Radiation Protection Division of the Concern Energoatom;
- Data transfer – Head of Crisis Center of the Concern Energoatom.

4. PDC CBS STRUCTURE

4.1. Plant level

On the plant level PDC CBS is functional integration of measurement equipment, computers and data transmitter hardware and software.

4.1.1. PDC CBC software

Software is performed in the client-server technology and consists of ORACLE data base and client applications – automatic working places (AWP).

PDC CBS may be separated at the five functional groups:

(1) PDC CBS Reference Guides:
- Plant Personnel Reference Guide;
- Plant divisions, subdivisions and departments Reference Guide;
- Plant controlled area buildings and rooms Reference Guide;
- Plant equipment Reference Guide;
- Radiation-dangerous work types Reference Guide;
- Plant stuff positions and categories Reference Guide;
- Individual protection means Reference Guide.

(2) Service software:
- AWP "DATA INPUTING" – provides interface of the data manual input;
- AWP "REPORTS EDITOR" – provides data preparation and correction (for data presentation and analysis);
- AWP «REPORTS» – provides data presentation on PC screens (via NPP INTRANET LAN) and print forms.

(3) Routine dose control software:
- AWP "ROUTINE CONTROL" – provides interface for wide range data input and correction;
- AWP "TLD doses input"- provides manual or file-oriented TLD doses data input;
- AWP "HARSHOW" – provides interface with HARSHOW[3] TLD system.
- AWP "RE"- provides interface with RE-2001 and RE-2000[4] TLD systems.

[3] Thermo Fisher Scientific Inc. - registered trademark and product
[4] Mirion Technology, Rados Technology Oy (Turku, Finland) trademark and product.

(4) Operational Dose Control software:

- AWP "DOSIMETRIC E-ORDER" – provides interface for preparing of special authorization for radiation-dangerous works development, including dose limits assignment;
- AWP "DUTY RADIATION SUPERVISOR" – provides interface for radiation-dangerous works development permission and electronic personnel dosimeters data input and output[5].

(5) Internal Dose Control software:

- Effective doses calculation software (placed on server) – provides calculation algorithm with the assumption of single inhalation radionuclides intakes;
- AWP "Internal Dose Control" – provides interface for WBC[6] control schedules development and correction, manual WBC measurements data input and correction;
- AWP "Measuring WBC" – provides interface for measurement of photon-emitted radionuclides content and allows to measure content of ^{51}Cr, ^{54}Mn, ^{59}Fe, ^{58}Co, ^{60}Co, ^{65}Zn, ^{95}Zr, ^{95}Nb, ^{103}Ru, ^{110m}Ag, ^{124}Sb, ^{141}Ce, ^{144}Ce in lungs and to measure content of ^{134}Cs, ^{137}Cs, ^{22}Na in whole body with the assumption of even/uniform activity distribution in whole body. "Measuring WBC" is developed on base HPG spectrometer and has 2-points measurement algorithm;
- AWP "Control WBC" – provides interface for measurements of ^{60}Co content in lung (with activity ≥300Bq) or for control the exceeding of summary activity threshold (450Bq) of ^{51}Cr, ^{54}Mn, ^{59}Fe, ^{58}Co, ^{65}Zn, ^{95}Zr, ^{95}Nb, ^{103}Ru, ^{110m}Ag, ^{124}Sb, ^{141}Ce, ^{144}Ce on the assumption of ^{60}Co is absent or for control the exceeding of summary activity threshold (400Bq) of ^{51}Cr, ^{54}Mn, ^{59}Fe, ^{58}Co, ^{65}Zn, ^{95}Zr, ^{95}Nb, ^{103}Ru, ^{110m}Ag, ^{124}Sb, ^{141}Ce, ^{144}Ce and ^{60}Co. "Control WBC" is developed on base of NaI(Tl) ∅6"×4" mm spectrometer;
- AWP "Iodine WBC" – provides interface for measurement of ^{131}I and ^{133}I content in thyroid gland. "Iodine WBC" is developed on the basis of NaI(Tl) ∅2,5"×2,5" mm spectrometer.

4.1.2. PDC CBS measurement equipment

In accordance with the Russian radiation protection regulations and standards, PDC CBC measurement equipment should provide:

- Routine control of external exposure on the basis of the automated TLD complexes;
- Operational control of external exposure on the basis of the electronic personnel dosimeters;
- Routine and operational control of internal exposure on the basis of the WBCs.

TLD system RE-2001(04) produced by Mirion Technology (Rados Technology Oy) and TLD system Harshaw produced by Thermo Fisher Scientific Inc are used for routine control at the plants.

A few types of electronic personnel dosimeters integrated in PDC CBS – DMC2000S, DMC2000GN, DMC2000XB (MGP Instruments, Lamanon, France) and RAD-51, RAD-52, RAD-62 (Rados Technology Oy (Turku, Finland) or assembled in Russia RAD-62 with name RAD-72 (produced by RADICO) are used for operational control at the plants.

For internal exposure control, WBCs produced by RADICO and Belorussian company "Atomtech" are used. CANBERA and ORTEC HPG spectrometers with the efficiency no less then 25% are used for detection units of "Measuring WBC".

4.1.3. PDC CBS hardware

PDC CBS hardware includes Data Base Server System, workstations for working places and active and passive data transmitters.

4.2. Headquarters level

On this level, PDC CBS represents the information integration of the all Russian plants PDC CBS on the basis of distributed database model. Information from local PDC centre is transferred via Crisis Center

[5] A few electronic personnel dosimeters types are integrated in PDC CBS – DMC2000S, DMC2000GN, DMC2000XB (MGP Instruments, Lamanon, France) and RAD-51, RAD-52, RAD-62 (Rados Technology Oy (Turku, Finland).
[6] Whole Body Counter.

communication channels - Data Transmission System. So, all dose control data from any plant or some plant groups or the all plants are available in headquarters.
To provide data comparability for all plants, PDC CBS classifiers are divided between:

Stuff categories

- maintenance personnel;
- operating personnel;
- contractors.

Equipment types

- Reactor and 1st reactor loop equipment;
- Other equipment.

Radiation-dangerous work types

- Works when reactor is stopped
- Works when reactor is operated.

5. PDC CBS IMPLEMENTATION

Since 1998, PDC system has been installed at all Russian NPPs, Ignalina (Lithuania) and Tianwan (China).