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STATUS AND RESULTS OF RUSSIAN NATIONAL STANDARD REFERENCE DATA SERVICE (50 YEARS SINCE FOUNDATION)

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The article describes NSRDS legal basis including summaries of Federal Law "On assurance of measurement uniformity," RF Government Decree "Regulations Concerning National Standard Reference Data Service on Physical Constants and Substances and Material's Properties," Rosstandart Administrative Order (April, 2016) concerning NSRDS Center, list of Rosstandart normative documents. Together with NSRDS structure and activity areas describe definition of SRD and NSRDS Procedures. The structure of the best SRD System in industry at "ROSATOM" is shown. Results of certification SRD and NSRDS Procedures for last years is presented together with Government Program. Described International (CIS) SRD System and some results of the System activity. Plans for next 10 years NSRDS development in presented.

Keywords: Standard Reference Data; National Standard Reference Data Service (NSRDS); NSRDS metrological procedure; NSRDS Center; properties of materials and substances; physical constants; NSRDS programs.

National Standard Reference Data Service (NSRDS) was established on the proposal of Prof. V. V. Boytsov (former chairman of USSR Gosstandart) in 1965 as per **USSR Council of Minister Decree "Regarding Improvements in Standardization Activities Nationalwide"** dated January 11, 1965 #16 [1].

Federal Law "On Assurance of Measurement Uniformity" dated June 26, 2008 # 102-FZ [2] is now the main legal document, which defines the service activities.

According to the article 21, p. 10 National Standard Reference Data Service on physical constants, substances and material's properties carries out its activities, focused on development and implementation of Standards Reference Data (SRD) into the science and engineering areas in order to provide on assurance of measurement uniformity based on use of abovementioned standards reference data, as well as maintains the appropriate sections of Federal Information Fund (FIF).

The Russian Federation Government Decree "Regulations Concerning National Standard Reference Data Service on Physical Constants and Substances and Material's Properties" dated August 20, 2001 # 596 [3] is the main ruling document on NSRDS.

The Government decree states objectives, structure and documents of NSRDS:

Art. 4. Standard reference data comprises physical constant's values as well as substances and material's properties should be determined according to established procedure and approved by Federal Agency for Technical Regulating and Metrology (Rosstandart).

Art. 5. NSRDS main objectives are:

a) Carrying out activities aimed at elaboration and application of SRD in the science, engineering and technology areas to provide unity of measurements on their base;

b) Delivering SRD to industrial, and scientific entities, as well as to other customers;

c) Determination and forecasting the needs for SRD;

d) Elaboration and implementation of SRD Development Programs;

e) Contribution to the international collaboration, representation of RF interests in the process of considering SRD application, implementation of international treaties in the area of substances and material's properties researches.

Art. 6. SRD development carried out by state scientific metrological institutions and other organizations under Ministry of Industry, Ministry of Energy, Ministry of Education, Russian Academy of Science and State Atomic Energy Corporation "Rosatom," utilizing technical, software and information tools and systems.

Art. 7. NSRDS managed by Rosstandart, while scientific and systematical support of NSRDS should be given by Rosstandart's Scientific Metrol-

ogy Center, named "Standard Reference Data" (NSRDS Center).

Art. 8. Documents, governing NSRDS activities, approved by Rosstandart.

Rosstandart Administrative Order "Regulations Concerning Rosstandart's Scientific Metrology Center "Standard Reference Data" (NSRDS Center)" dated April 4, 2016 # 393 [4] states area and order of NSRDS functions and activities within the framework of Rosstandart and VNIIMS:

1. NSRDS Center functions are performed by VNIIMS.

2. Rosstandart should organize activities of NSRDS Center focused on SRD development and implementation, as well as keeping records of appropriate sections of Federal Information Fund on Assurance of Measurement Uniformity.

3. NSRDS Center in its activities is governed by RF laws, Federal Agency for Technical Regulating and Metrology administrative orders, NSRDS Regulations, VNIIMS Articles of Association, and regulatory documents regarding Assurance of Measurement Uniformity.

4. NSRDS Center main functions are:

a) Organizing the development and implementation of SRD to assurance of measurement uniformity in priority areas of science and technology development;

b) Organizing research and methodological support of NSRDS activities, including:

contributing to arrangement and implementation of SRD development programs, including Standards Development Programs in RF;

conducting scientific and technical expert reviews and certifications of reference data, methods for data collection, as well as validity of reference data, databases and databanks on substances and material's properties;

depositing NSRDS documents, containing certified data;

performing examination of official, reference and informational editions on substances and material properties;

organizing activity of TC-180 Secretariat "National Standard Reference Data Service."

Besides three documents mentioned above there is over dozen of Standards, Guides and Recommendations, which define many areas of NSRDS activity:

GOST R 8.614–2005. GSI (State System for ensuring the uniformity of measurements). National Standard Reference Data Service. General Rules [5];

GOST 8.566–2011. GSI. Intergovernmental Data System on Physical Constants, Substances, and Material's Properties. General Rules [6];

RD 50-382–83. Methodology Guidelines. Procedure for Elaboration of Standard Reference and Recommended Reference Data Tables;

RD 50-383–83. Guide. Procedure for Registration Standard Reference and Recommended Reference Data Tables;

R 50.2.067–2009. Recommendation on Metrology. Validation of Data on Physical Constants, Substances and Material Properties. General Rules;

MI 2215–92. Recommendation. GSI. Databases and Databanks. General Provisions and Certification Procedure.

The main products of NSRDS are SRD, Recommended Reference Data (RRD) and NSRDS metrological procedures. Table 1 describes data definitions and certification procedures.

The scheme in Fig. 1 below presents NSRD system structure and activities area international organization: ISO — International Standards Organization; IAPWS — The International Association for the Properties of Water and Steam; IAAE — International Agency Atomic Energy; CODATA — Committee on Data for Science and Technology; IUPAC — International Union of Pure and Applied Chemistry. These organizations approve and issues very important international ta-

TABLE 1. Definitions and Certifications Procedures

Definitions	Certification Procedures
Standard Reference Data (SRD): Data on physical constants, substances and material's properties, represented in numerical or analytical form that passed examination in NSRDS Center, and approval from Federal agency (Rosstandart).	TC-180 and NSRDS Center shall organize expertise of draft tables. SRD Tables, approved by Rosstandart, registered by NSRDS Center and added to the Federal Information Fund on Assurance of Measurement Uniformity (FIF).
Recommended Reference Data (RRD): Data on physical constants, substances or material's properties, represented in numerical or analytical form that passed examination and certification in NSRDS Center.	Certification of RRD Tables and NSRDS Procedures shall be done by VNIIMS along with NSRDS Center according GOST R 8.614–2005; Approved RRD Tables and NSRDS Procedures registered at NSRDS Center and added to FIF.
NSRDS Metrological Procedure: Metrological procedure for calculated or experimental determination of data on substances or material's properties.	

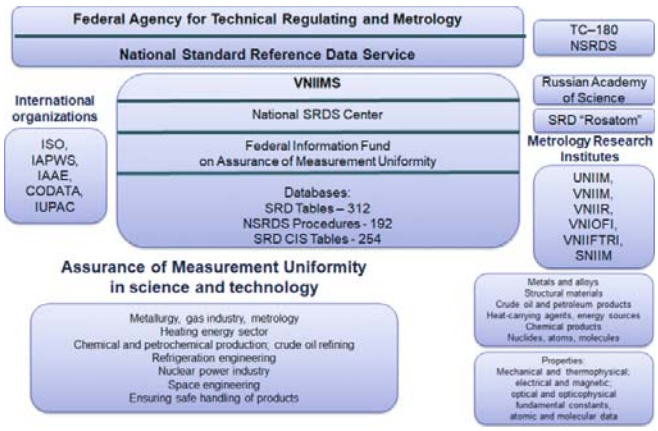

Fig. 1. Russian NSRD Service activity

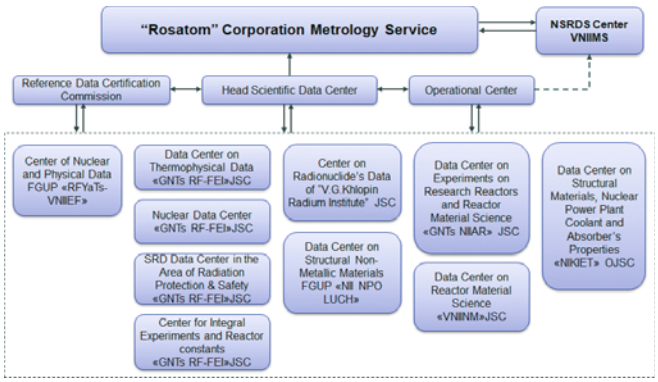

Fig. 2. The structure and data centers of Rosatom

bles on properties of materials and substances, which became SRD.

The basic products of NSRD Service is Standard Reference Data tables, which produces every year according the **National Program "Development of Industry and its Competitive Growth"** the RF Government Decree dated April 15, 2014.

Sub-Program 8 is "Development of Technical Regulating System, Standardization and Assurance of Measurement Uniformity" [7].

Program target indicators and figures are:

level of harmonization and the number of approved national standards;

number of approved primary State measurement standards;

accuracy of national and international time scales;

number of registered Standard Reference Data.

The program provide budget financing for 15 SRD tables each year until 2020.

In Table 2 the total number of certified Standard Reference Data and certified NSRDS metrological procedures in main areas as of 1.01.2017 are presented.

The Rosatom Corporation has the most developed industrial Standard Reference Data System in Russia, which works with NSRDS Center and approves the joint Documents and Standard Reference Data. The structure and data centers of the System are shown in Fig. 2.

In October 6, 1992 in Tashkent City CIS, countries signed the **Collaboration Agreement on generation and use of data on physical constants and substances and material's properties**.

According to the Agreement the Intergovernmental Data System on Physical Constants, Substances and Material's Properties of CIS Members (IDS) was developed.

The IDS works according to the GOST 8.566–2011 "GSI. Intergovernmental Data System

TABLE 2. Certified SRD Tables and NSRDS metrological procedures

Scope of Use	Quantity	
	SRD Tables	NSRDS metrological procedures
Metrology (dilatometry, pure materials, etc.)	53	14
Prospecting, production, processing and pipeline transport	59	23
Power energy and energy saving	36	27
Atomic energy industry, including safety	16	32
Risk reduction and mitigation of consequences of natural disasters and man-induced disasters	4	9
Laser and electronic-ion-plasma technologies	13	19
Nanotechnologies and nanomaterials	16	14
Diaphragm construction and catalyst system technologies	17	24
Ferropiezoceramics and semiconductor materials	34	26
High-energy state of metals	64	4
In total:	312	192

TABLE 3. Certified SRD CIS Tables

Scope of Use	Quantity
Metrology (dilatometry, pure materials, etc.)	38
Prospecting, production, processing and pipeline transport	53
Power energy and energy saving	7
Atomic energy industry, including safety	20
Risk reduction and mitigation of consequences of natural disasters and man-induced disasters	24
Laser and electronic-ion-plasma technologies	13
Nanotechnologies and nanomaterials	11
Diaphragm construction and catalyst system technologies	14
Ferropiezoceramics and semiconductor materials	22
High-energy state of metals	52
In total:	254

on Physical Constants and substances and Material's Properties. Main Principles."

There are following data definitions and certification procedure for SRD CIS:

data on physical constants, substances and material's properties, represented in numerical or analytical form that passed examination and certification in SRD CIS System and is approved by MGS Council under the notion of STD or SD category;

SRD CIS Tables developer should submit draft tables to MTC 180 Committee for certification. MTC 180 should arrange expert review and send tables to MGS for approval;

Tables, approved by MTC 180, are registered in the SRD CIS Table's Register.

CIS SRD tables are developing according to MGS program on elaboration of certified data: "program on elaboration of Standard Reference Data on physical constants, substances and material's properties in specific disciplines for 2016 – 2018" approved at 48th MGS Session:

section 1. Physical constants — 4 STD Tables;

section 2. Data on solid material's properties — 12 STD Tables;

section 3. Data on properties of gases and liquids — 13 STD Tables (29 STD Tables in total).

Since the foundation of CIS SRD System 254 tables were developed and certified (Table 3).

During the next 10 years the National Standard Reference Data Service will develop following main directions:

supply industry and science Standard Reference Data for new materials and substances and new innovation technologies and projects;

supply industry Standard Reference Data for developing of digital economy (in particular problem of mathematic modeling);

organize several industrial Standard Reference Data Systems using "Rosatom" experience and example;

organize NSRDS Center on properties of Hydrocarbons for flow (volume) and quality measurements;

update most of the NSRDS legal documents;

increase the international cooperation in area of data for science and technology, especially within the frame work of CODATA.

REFERENCES

1. The USSR Council of Minister Decree "Regarding Improvements in Standardization Activities Nationalwide."
2. The Federal Law "On Assurance of Measurement Uniformity."
3. The Russian Federation Government Decree "Regulations Concerning National Standard Reference Data Service on Physical Constants and Substances and Material's Properties."
4. The Rosstandart Administrative Order "Regulations Concerning Rosstandart's Scientific Metrology Center "Standard Reference Data" (NSRDS Center)."
5. GOST R 8.614–2005. GSI (State System for ensuring the uniformity of measurement). National Standard Reference Data Service. General Rules.
6. GOST 8.566–2011. GSI. Intergovernmental Data System on Physical Constants, Substances, and Material's Properties. General Rules.
7. The National Program "Development of Industry and its Competitive Growth" the RF Government Decree. Sub-Program 8. "Development of Technical Regulating System, Standardization and Assurance of Measurement Uniformity."