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Implementation of the *ISSA-ILO Guidelines on Actuarial Work for Social Security* into the practice of the Pension Fund of the Russian Federation

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1. Introduction

Guidelines on Actuarial Work for Social Security (hereafter referred to as ISSA-ILO Actuarial Guidelines) generalize and make available to the public advanced theoretical and practical experience of countries with a long history of actuarial work development in the social security programs (hereinafter, SSP) of a nationwide scale.

Modern Russian actuarial legislation has not covered this area in its regulatory framework, excluding state off-budget funds (PFR, FSS, FOMS) from compulsory actuarial valuations (Figure 1).

Figure 1. *Programmes subject to mandatory actuarial valuations in the Russian Federation*


Programmes subject to mandatory actuarial valuations (established by the Federal Law of 02.11.2013 No. 293-FZ "On actuarial activity in the Russian Federation")				
Activity of the authorized body in developing insurance "tarifs for compulsory insurance	Activity of non-state pension funds	Activities of insurance organizations, except for insurance organizations for compulsory insurance	Activity of mutual insurance societies	Activities of other bodies and organizations (can be installed separately by the Federal Law)

The actuaries of the PFR demonstrated leadership as they took an active part in preparing questions and proposals for its content both at the development stage and after publication. For the same reason, senior officials of the Fund decided to implement this framework as soon as possible.

2. Features of actuarial work in the Pension Fund of the Russian Federation

Actuarial activities in the PFR began to be carried out from the mid-1990s, several years after the creation of the Fund. The first actuarial units in the PFR were established in 2000. Since 2008, the PFR at the federal level operates the Department of Actuarial Calculations and Strategy Planning. Specialists in the field of actuarial activities work in territorial authorities of the PFR in each constituent entity of the Russian Federation (Figure 2).

Figure 2. *Structure of the Actuarial Department in the Pension Fund of the Russian Federation (Federal level)*
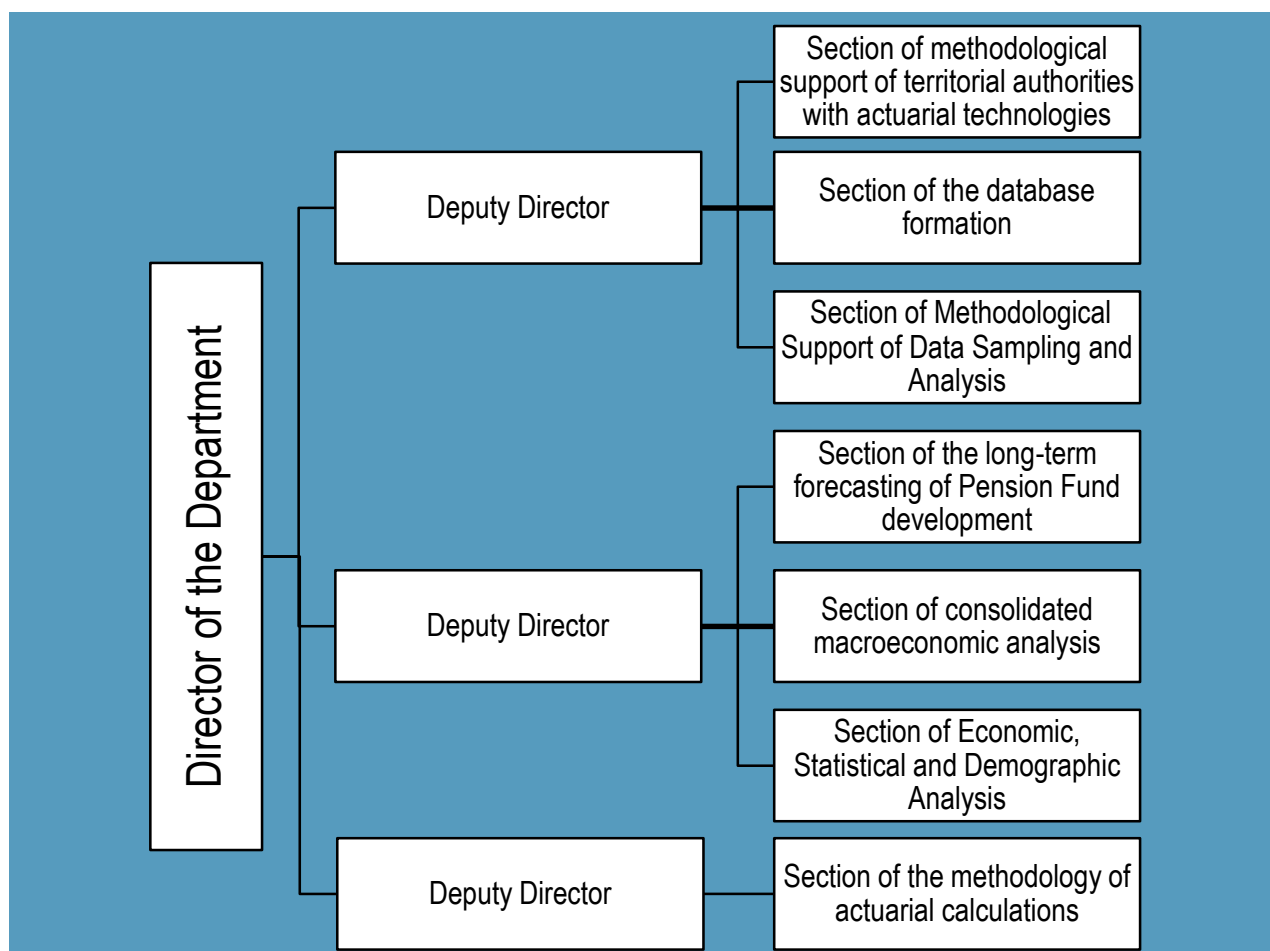
However, over the past years, neither the Regulation on the Pension Fund of the Russian Federation, nor other statutory acts related to the management of the pension system, have included the rules governing the implementation of actuarial activities in relation to the PFR.

The absence of legislative or even normative requirement – at the level of the Government of Russia – to produce an actuarial valuation of the PFR remains the main obstacle to an effective implementation of the actuarial function within the PFR.

The PFR is an element of the budgetary system of Russia and part of the budgetary process, tightly regulated in the Budget Code of the Russian Federation. By law, the development of the budget of the PFR and the federal budget, which bears subsidiary responsibility for the obligations of the PFR, does not require recording the results of the actuarial evaluation of the PFR. The development of laws on pension reform, which has been implemented in our country since 2002, also does not require mandatory actuarial valuation and due consideration of its results.

Despite the absence of legal requirements on all issues related to the development of the mandatory pension insurance system (the main component of the Russian pension system) the PFR actuaries carry out actuarial calculations and assessments of the current system including proposed reforms. The results of the actuarial evaluation are submitted to the Ministry of Labor of Russia who subsequently reported to the Government and the President.

Due to the need for actuarial assessments of the PFR's activities at the highest level of government management, the Fund's specialists have accumulated a wide actuarial experience over the past decade. Most of the recommendations of the ISSA – ILO Actuarial Guidelines have been practically implemented, although not all of them have the required legislative form.

Actuarial work for any social security programme (SSP) is based on three pillars: actuarial database, actuarial methodology and actuarial projection model (Figure 3). All three pillars are closely interconnected and define the content of each other. Moreover the extent of their content is determined by the number and specificity of the SSP carried out by the social security institution (SSI).

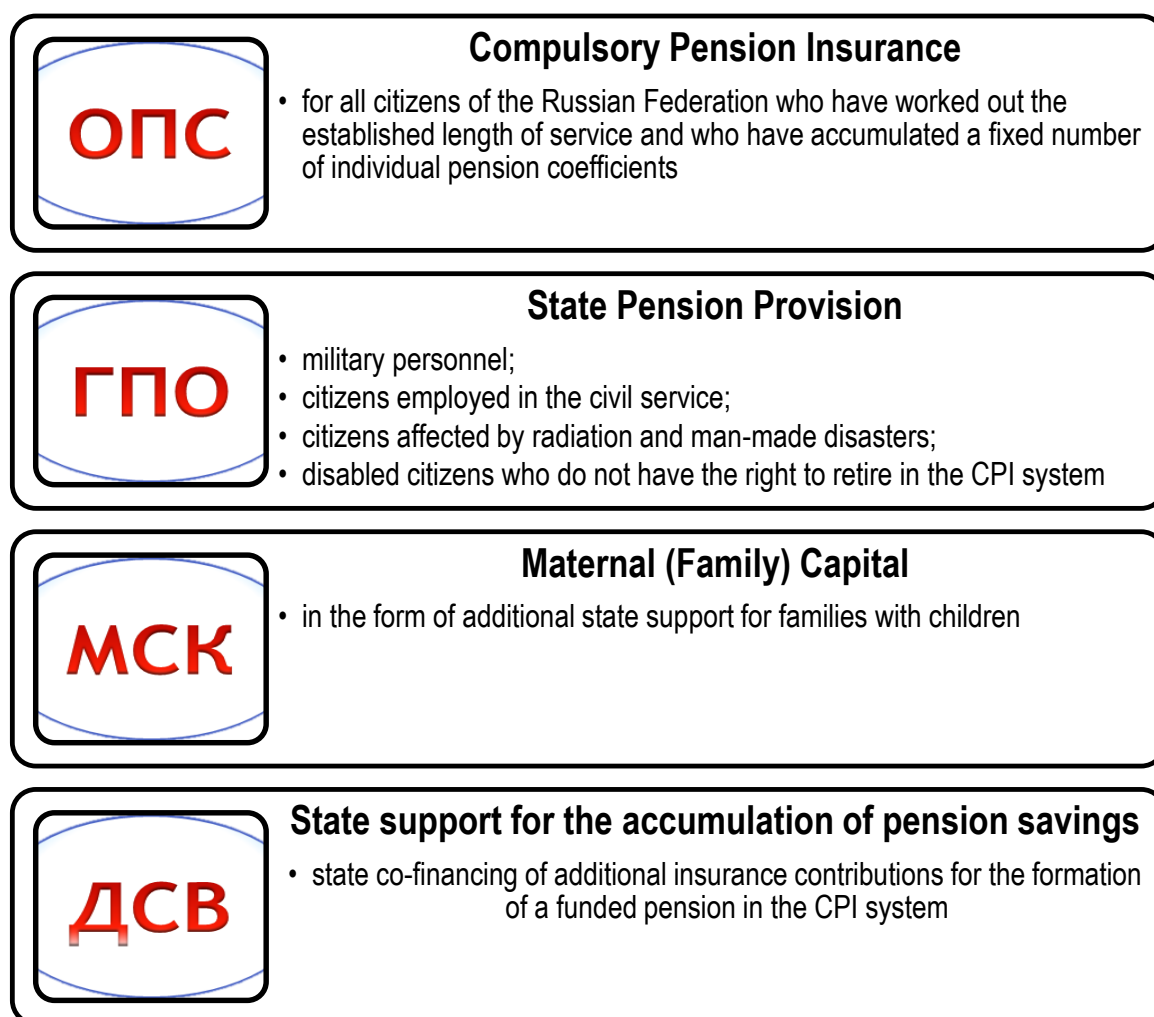**Figure 3.** *Basic tools of actuarial work*
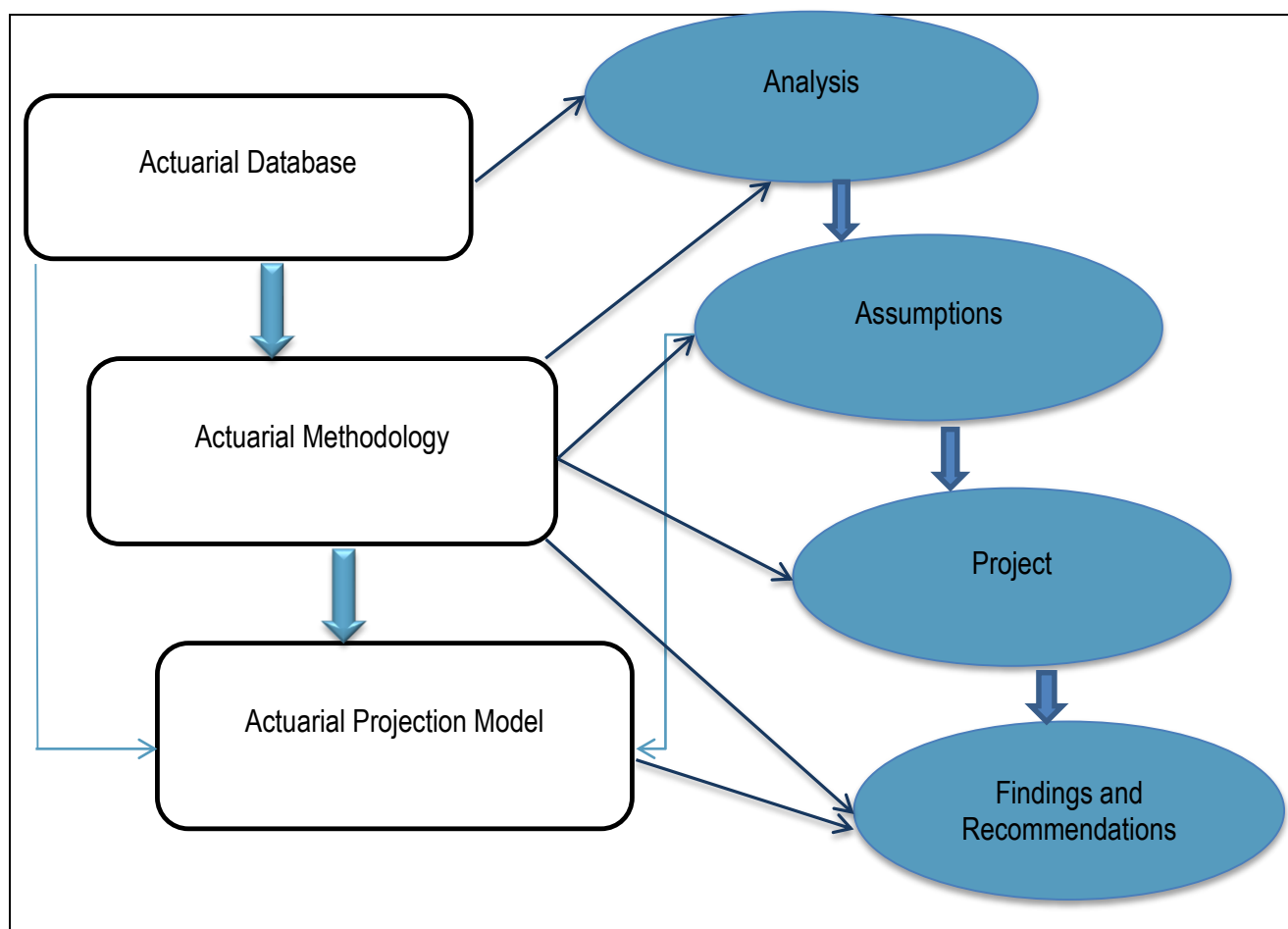
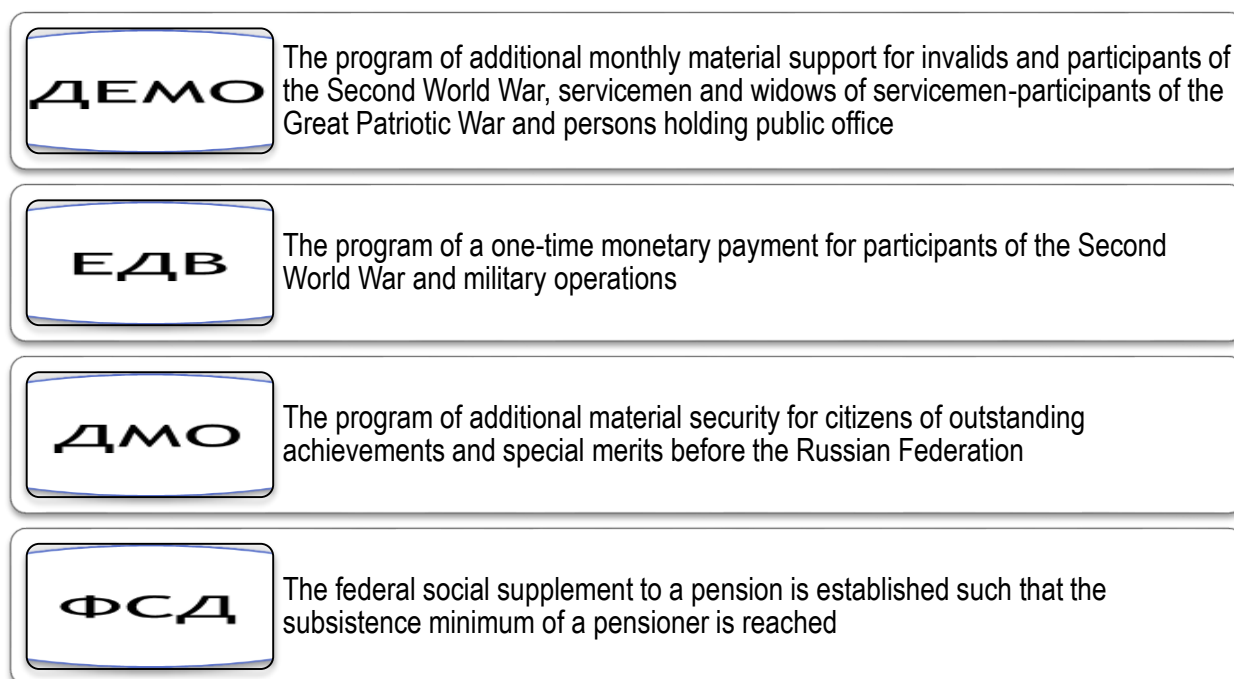The PFR manages four social security programs (Figure 4):

- compulsory pension insurance (CPI), including distribution and accumulation components;

- state pension provision;

- a program of state support for the accumulation of pension savings;

- a program of additional measures of state support for families with children (maternal (family) capital).

Figure 4. *Major social security programs managed by the PFR*

Compulsory Pension Insurance

ОПС

- for all citizens of the Russian Federation who have worked out the established length of service and who have accumulated a fixed number of individual pension coefficients

State Pension Provision

ГПО

- military personnel;
- citizens employed in the civil service;
- citizens affected by radiation and man-made disasters;
- disabled citizens who do not have the right to retire in the CPI system

Maternal (Family) Capital

МСК

- in the form of additional state support for families with children

State support for the accumulation of pension savings

ДСВ

- state co-financing of additional insurance contributions for the formation of a funded pension in the CPI system

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In addition, the PFR administers the payment of more than ten types of social benefits, which are financed from the federal budget and are provided to both pensioners and non-pensioners. These benefits are compulsory paid to specific beneficiaries, the provisions are defined in legislation the source of financing is known and therefore they can be classified as a SSP. These include, for example, a monthly benefit (EDV) that is a federal social supplement to a pension to meet the subsistence minimum for a pensioner in its region of residence (FSD), etc. (Figure 5).

Figure 5. *Additional social security programs managed by the PFR*

ДЕМО	The program of additional monthly material support for invalids and participants of the Second World War, servicemen and widows of servicemen-participants of the Great Patriotic War and persons holding public office
ЕДВ	The program of a one-time monetary payment for participants of the Second World War and military operations
ДМО	The program of additional material security for citizens of outstanding achievements and special merits before the Russian Federation
ФСД	The federal social supplement to a pension is established such that the subsistence minimum of a pensioner is reached

Actuarial calculations are carried out by the PFR's actuaries in relation to all the programs and payments made by the Fund, as required by the ISSA-ILO Actuarial Guidelines.

But the most interesting feature for Ministry of Labor of Russia and other federal authorities are the actuarial projections concerning financial sustainability of the Compulsory Pension Insurance (CPI) system. This is due to the complexity of the legal rules that determine the pension rights of insured persons and the financial obligations and the subsidiary responsibility of the federal budget.

The CPI system is the largest component of the Russian pension system and the most difficult to project because of the variety of influencing factors and the uncertainty of performance results.

Among the social security programs managed by the Pension Fund, the distribution component of the CPI system requires very complex actuarial calculations and a detailed database for its effective implementation. In all other SSP managed by the PFR, the conditions for calculating the amounts of payments are much simpler. Doing actuarial calculations for these programs does not cause any special difficulties and does not require such an extensive database as for the CPI system.

The Pension Fund of Russia strives to fully implement all the recommendations of the ISSA-ILO Actuarial Guidelines. However, in addition to the mentioned difficulties caused by the gaps in the Russian actuarial legislation, there are some deficiencies in these Guidelines which complicate the organization of actuarial activities in the PFR.

The main deficiency is the lack of detail and clarity of recommendations about the organization and interaction of different departments within a social security institution while ensuring the implementation of actuarial work.

The ISSA-ILO Actuarial Guidelines is complete and understandable for organizations with an established actuarial valuation system, where everything is set up and defined in legislation. But it contains many gaps and ambiguities for those countries and social security institutions which have yet to organize effective actuarial work concerning their SSP. These gaps have to be filled by each such country and each social security institution in accordance with its own understanding of the contents of the relevant recommendations of the Actuarial Guidelines.

Priorities for the implementation of the Actuarial Guidelines in the practice of the PFR are the database for actuarial calculations and the actuarial projection model – the two key elements that ensure the implementation of actuarial activities. The PFR gives a high priority to such that content and processes will meet the requirements of the ISSA-ILO Actuarial Guidelines. These elements are regulated by Recommendation No. 2 "Data" and Recommendation No. 5 "Projection Model".

3. Objectives and problems of the creation of the database for actuarial calculations

Sufficient and reliable data are the most important conditions for carrying out actuarial activities properly. Recommendation No. 2 requires the Social Security Institution to address three data objectives under which only the first is related to actuarial activity:

- ensuring the availability of sufficient and reliable data needed for the implementation of actuarial activities;

- ensuring the reliability of data for each individual participant such that beneficiaries will receive the right amount according to plan provisions;

- ensuring compliance with data privacy legislation and national standards.

The actuary needs to perform four tasks:

- provide an opinion on the sufficiency and reliability of the data;

- evaluate any changes made to the data;

- evaluate the consequences of using imperfect data on social security scheme participants and provisions;

- provide recommendations for improving the quality of data.

Analysis of the contents of Recommendation No. 2 showed that its implementation should be confirmed by the adoption of 6 types of documents (5 internal and 1 external).

- Internal documents:

  – document establishing the responsibility for the content of a sufficient and reliable database for actuarial calculations;

  – document establishing the actuary's access to the necessary data;

  – document describing data requirements (elements, sources, data formats, description of the use of data);

- document monitoring regular data verification procedures;

- document describing the data validation processes (sufficiency, reliability, consistency between themselves and with external sources).

- The external document required by Recommendation No. 2 is a document ruling and describing the information exchange with other organizations (including national / international), which should guarantee information support of actuarial activity with data from external sources, including how to proceed to assess reformed or newly created systems in the absence of reliable data.

Before talking on how assigned tasks are decided by the PFR and by which documents their decision is confirmed, it is important to note several gaps in the Actuarial Guidelines, which are fundamental for the PFR.

The actuarial guidelines require that the Social Security Institution must ensure sufficient and reliable data for actuarial work. However the Actuarial Guidelines does not indicate the best way to get these data and how to create a database for actuarial calculations.

The first question is whether it should be an integral part of the database of SSP participants, which the administrator is required to maintain in accordance with Recommendation No. 2? Or, it is more efficient to create a database of actuarial calculations separately, especially since in addition to data of SSP participants, it should contain information on external – socio-economic – factors affecting the development of SSP. The owners of this information are, as a rule, national statistical bodies, and not social security institutions. Is it better to create an actuarial database outside the Social Security Institution – for example, at the interagency level?

The second question is who should be responsible for the creation of a database for actuarial calculations, for developing indicators for actuarial performance based on data from primary sources? Actuaries or other units of the social security institution? The practice of actuarial activities in the PFR shows that, in addition to the SSI actuaries, no other external or internal specialists can substantively know and understand exactly which indicators are necessary for the implementation of actuarial calculations. Consequently, the participation of actuaries of the SSI in the creation of the actuarial database, or at least their methodological guidance of this process, is inevitable. However, as practice shows, the tasks of informational support of actuarial activity in the absence of legislative requirement of the need for actuarial valuation of SSP are not a priority even within the SSP itself, not to mention external organizations. Moreover formally attributing the responsibility for the formation of an actuarial database does not mean its actual creation in the required time taking into account the time needed to perform any actuarial activity.

The third question is to what extent should actuaries be allowed to verify data from primary sources? According to the ISSA-ILO Actuarial Guidelines they must draw conclusions about the reliability of the data used. If they do not participate in the verification of the primary sources of data, accordingly, they cannot be sure of its reliability. If they are involved, then it creates a significant additional burden, requiring more staff of specialists in actuarial calculations, which will specialize only in checking the primary data and forming the database of actuarial calculations.

Given the lack of the ISSA-ILO Actuarial Guidelines on the best way to organize the actuarial calculations database, each country, depending on the technical capabilities and specificity of

existing information systems, should either form a separate actuarial database or provide an opportunity for actuaries to obtain the actuarial data necessary for actuarial activity from the relevant information systems (both internal and external).

4. Stages of the database creation for actuarial calculations in the PFR

The PFR underwent three stages of creating a database for actuarial calculations, and at each stage the approaches to solving this problem fundamentally changed.

At the first stage – before the pension reform in 2002, statistics of the pension system was minimal in the model of the state pension system, and all the information systems of the Fund were focused only on the registration of information about the pension scheme participants and were not intended for analytical calculations. A specialized database for actuarial calculations in its modern sense did not exist. Actuaries were only available forms of state and departmental statistical reporting with a very limited set of indicators and measurements. This reporting was collected and stored as a set of files of an approved format, which did not allow for in-depth analytical calculations. For most of the external data used in actuarial calculations, this collection procedure has been preserved to this day.

In the conditions of pension reform, when fundamentally new insurance components of the pension system were introduced, a much wider range of information was required for their actuarial valuation. Therefore, in the second stage, in 2004, the PFR decided to create a specialized, independent database of actuarial calculations[1]. Thus, back in 2004–05, The PFR has documented the access of actuaries required by Recommendation No. 2 to the data necessary for actuarial activities and identifies those responsible for filling the database and its functioning.

The decision made allowed to accumulate in the database the types of data required by Recommendation No. 2:

- external data relating to the demographic and macroeconomic conditions of the pension system functioning;

- internal data of PFR information systems about active participants and beneficiaries of all social security programs managed by the PFR, as well as all changes in SSP that occurred in the recent history of Russia.

The PFR obtains external data relating to the demographic and macroeconomic conditions of the pension system in the following ways:

- data with public access – from official websites of relevant federal bodies;

- unpublished data – on special written requests sent to the relevant information holders or within the framework of bilateral agreements on information sharing, which fully meets the requirements of the Actuarial Guidelines.

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[1] This decision is fixed by the Resolution of the Board of the PFR of 06.10.2004 No. 147p "On approval of the Concept for the formation of a database for information and statistical support of actuarial calculations in the compulsory pension insurance system", as well as the Plan for its implementation approved in 2005

External data in the form of files in a format maintained by the holders of the relevant information are stored by the PFR's actuaries in a special data catalog. This is not the most effective way of presenting and storing, because it significantly limits the ability to compile and analyze data. However, to date, this is the only way that allows the PFR's actuaries to have at their disposal all the external information of different formats from various sources necessary for actuarial work. The attempts made in the mid-2000s to create a special database of external information in the PFR were deemed ineffective due to the excessive cost of this work and because the information was only available in the same format as the one available from websites organizations.

In the long term, as the interdepartmental information systems are being set up in Russia, work is currently under way to create a broader statistical system with more than 6,000 indicators where more than 60 agencies are involved in its creation. It is assumed that the opportunities for access to information from external sources, the convenience of its use, the range of indicators and their measurements will significantly expand. This new statistical system will allow PFR's actuaries to stop maintaining a catalog of external data and to start analyzing data directly using the capabilities of the new information system.

Formation of the actuarial database on the basis of internal data of the PFR information systems on active participants and beneficiaries in the context of the ongoing changes in the SSP is closely related to the level of development of the automated information system of the PFR (AIS PFR) and the possibilities of using its data for analytical purposes.

For a long time, information about the pension program and its active participants (insured persons) that were downloaded to the actuarial database covered only the period from 2002, i.e. only the norms of the new pension legislation. Information on past periods of the formation of pension rights (when the norms of the previous laws on pensions were in effect) appeared in the actuarial database since 2013, when the law completed the process of converting (recounting) all pension rights earned by insured persons to pension reform. To date, the PFR's actuaries have access to information for each insured person for the maximum possible period – i.e. from the moment of commencement of employment to its end, or until 2017, if a person has not yet retired and continues to accrue pension rights.

Information systems of the PFR, containing data on active participants and on beneficiaries, were constructed in different ways.

The data on active participants were initially centralized at the federal level in the database of insured persons called Personalized Accounting System and therefore began to be downloaded to the actuarial database since 2004 as soon as a decision was taken on its formation.

Data on the beneficiaries (pensioners and recipients of other payments) until 2014 were kept exclusively at the regional level – in the regional program-technical complexes for the appointment and payment of pensions and benefits – and their centralization to the federal level was a mini mall. For a long time, data on the beneficiaries were collected in the form of several forms of approved state and departmental statistical reporting.

Therefore, the opportunities for providing access to them by actuaries were extremely limited.

Since 2009, specialists of the Department of Actuarial Calculations and Strategy Planning and specialists in the regional offices of the PFR have developed their own software and sampled data on the recipients of pensions and social benefits. Although this work does not belong to

the functions of actuaries according to the ISAPs and the Actuarial Guidelines, it turned out to be extremely laborious and involved significant technical difficulties. However its implementation allowed the actuaries, to provide actuarial activities to the PFR with the necessary data on the beneficiaries, and also to accumulate a vast experience in validating the data for the actuarial database.

Until 2014, part of the database, based on internal data, was formed separately from the other information systems of the PFR in the form of two independent and unrelated modules: SC DA (software complex data analysis) and K1101.

Data on the insured persons for the entire period of accrual of their pension rights, unloaded from the Personalized Accounting System, were collected and stored in the SC DA at the federal level. Its formation since 2004 was dealt with by a specialized division of information technology with the methodological participation of actuarial specialists. The information stored in the SC DA with the help of OLAP cubes technology is converted into reports with the required actuarial indicators and measurements, which are then used for the purposes of actuarial analysis and projection.

Data on beneficiaries by the specialists of the actuarial calculations of the PFR branches, at the special request of the Department of Actuarial Calculations and Strategy Planning, were selected from the regional databases, checked and accumulated in modules K1101 (the working name of the module accumulating data on recipients of payments used by actuaries) at the regional level. Then the obtained sample of the PFR branch was sent to the federal level (to the Executive Directorate of the PFR) for subsequent reconciliation and aggregation. The Department of Actuarial Calculations and Strategy Planning synchronized these data and formed the federal module K1101, which contains information on beneficiaries from all regions of the country. In this way, data samples for 2008–2013 were formed. Using the technology of OLAP cubes, the information of the module K1101, just as in the SC DA, was converted into reports with the required actuarial indicators.

With the transition to a new stage in the development of the automated information system of the PFR (AIS PFR), approaches to providing actuaries with internal data and the formation of actuarial database have changed.

Since 2012, the formation of the actuarial database is carried out in accordance with the Concept of the Development of the AIS PFR[2].

One of the goals of the Concept was to create a single information space that provides high speed of access to information resources of the PFR. Information support of the actuarial evaluation of the pension system is indicated in the Concept as one of the main directions for the development of the AIS PFR.

The target architecture of the AIS PFR provides the information-analytical and reporting subsystem (IAS AIS PFR) designed to accumulate, compare and analyze information resources of the AIS PFR and other external information sources. It also evaluates the effectiveness and efficiency of the organizational structures of the PFR and ensures the actuarial valuation of the CPI system including projections for the development of the pension system for the medium

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2. Approved by the Resolution of the Board of the PFR No. 474r dated December 29, 2012 "On the Concept for the Development of the Automated Information System of the Pension Fund of the Russian Federation for 2012–2016 years".

and long term. Within the framework of the IAS of the AIS PFR, two modules have been created for information support of actuarial calculations:

- ASAC PAS – "Analytical support of actuarial calculations" based on the information of the Personalized Accounting System. It replaces the SC DA and inherits all the information and the multidimensional cubes formed earlier in it;

- ASAC FDBP – "Analytical support of actuarial calculations" on the basis of data of the Federal database of pensioners (FDBP). This new module, formed at the federal level from a single centralized source, is intended to replace the sample of data carried out by the PFR and the Department of Actuarial Calculations and Strategy Planning and stored in the K1101 database.

The creation of the ASAC FDBP module became possible due to the commissioning in 2014 of a new – one-in-one office for the PFR – a software and hardware complex for the appointment (payment) of pensions and other benefits. As a result, it became possible to centralize a large part of the information on beneficiaries from the regional level to the federal level, in the Federal database of pensioners.

In this regard, the sample of beneficiary data, conducted earlier by the actuarial experts in the regions under the K1101 project, was discontinued.

However, since 2017, due to delays in the formation and debugging of the ASAC FDBP module, the Department of Actuarial Calculations and Strategy Planning, together with the PFR offices in all regions of the Russian Federation, have resumed work on data sampling within the framework of the K1101 project. The data is selected in 2015-2017. Such a decision has two goals:

- prompt receipt of data necessary for actuarial calculations on beneficiaries that are not yet available in the ASAC of the FDBP;

- provision of additional control by the actuarial service of the PFR for the reliability of the data loaded in the ASAC FDBP, and data in the original sources.

In 2017, the Board of the PFR adopted an order "On the organization of work on the formation, filling and use of the information-analytical resource of the PFR (No. 641p of 14.11.2017)".

This order completed the implementation of Recommendation No. 2 and its first principle, providing for the adoption of a document establishing the responsibility for the management of data within the organization, and the maintenance of a sufficient and reliable database for actuarial calculations.

The order approved:

- the composition of the information-analytical resource of the PFR (IAR PFR) required by various departments, including the Department of Actuarial Calculations and Strategy Planning, to carry out their activities and generate reports;

- distribution of functions for the formation, filling and use of the IAR PFR (Figure 6).

Figure 6. *Distribution of responsibility for data management in the PFR and the content of a sufficient
and reliable database for actuarial calculations*
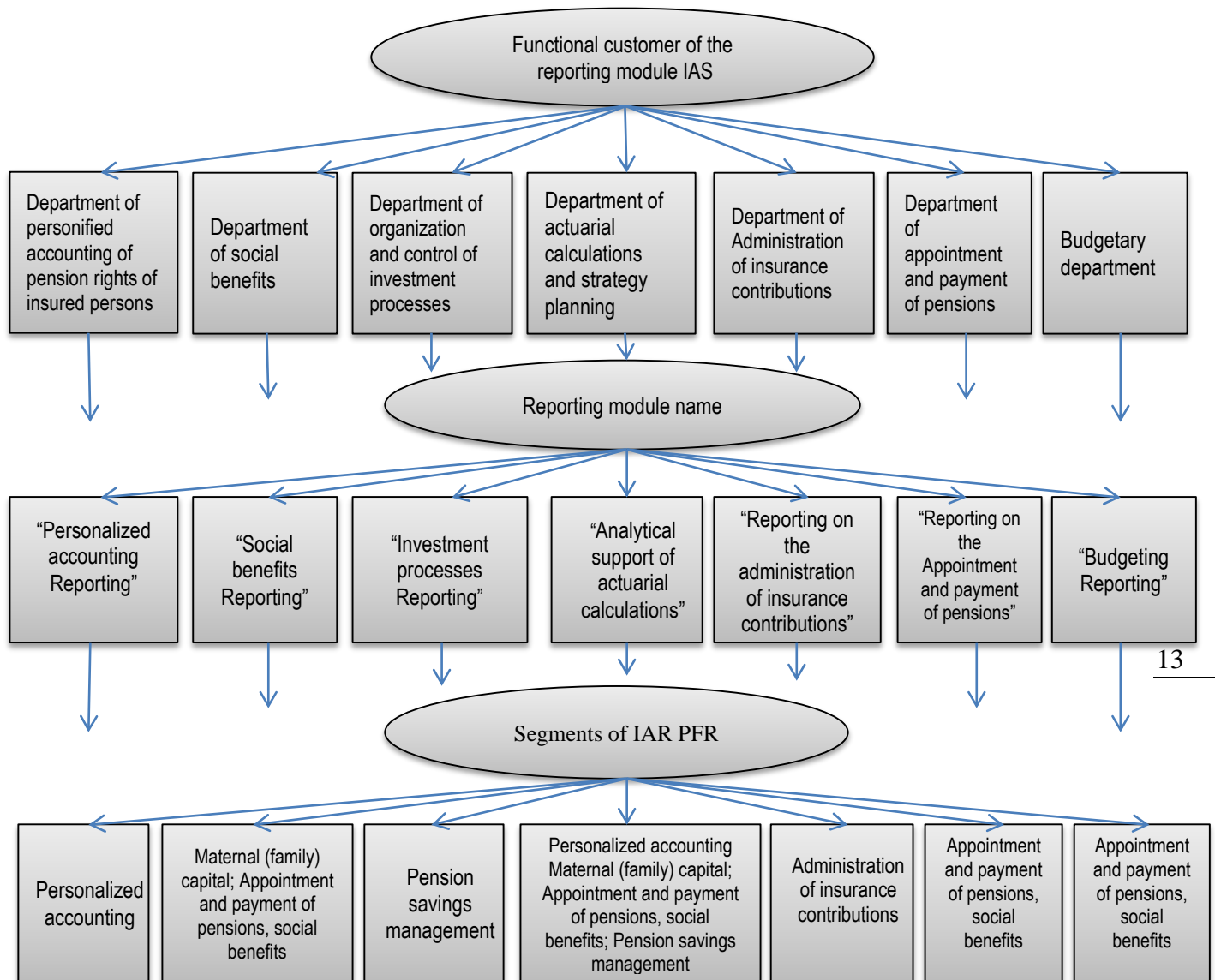
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IAR PFR includes 5 segments: personalized accounting, maternity (family capital),
management of pension savings, assignment and payment of pensions and social benefits and
administration of pension contributions.

Within the distribution of functions for the creation, filling and use of the IAR PFR the
following were defined:

- PFR departments, responsible for the formation of data sources for each type of IAR
  PFR (for receiving documents / information, entering information, monitoring the
  integrity of data of AIS PFR subsystems, which are the source of information for the
  IAR PFR);

- responsibility for defining the data model of each segment of the IAR, filling the
  segments with data and controlling the integrity of the data;

- the reporting modules of the IAS of the AIS PFR, formed on the basis of the IAR PFR;

- functional customers of each reporting module of the IAS AIS PFR are responsible for determining the composition of reports, developing methodologies and agreeing algorithms for the formation of reporting indicators, methodological support and coordination of work on the use of reporting modules.

Sources of information for the ASAC IAS AIS PFR are currently 4 of the five segments of the PFR. For the definition of the data model, filling and monitoring the integrity of the data, four specialized structural subdivisions of the PFR (functional customers) are responsible for them:

- Department of personalized accounting of pension rights of insured persons;

- Department of Social Benefits;

- Department for the organization and control of investment processes;

- Department of the organization of appointment and payment of pensions.

Technological support of the IAS and the maintenance of the data model of the IAR PFR is entrusted to the Information Technology Department, and the maintenance of the consolidated PFR databases (the primary sources of data for the IAR PFR) to the territorial offices of the PFR and the Interregional Information Center of the PFR.

Thus, the formation of a database of actuarial calculations based on internal PFR data implies the collegial work of seven Departments, including the Department of Actuarial Calculations and Strategic Planning, particularly with regard to data quality control, development and collegial review of methodologies and algorithms for verifying data and calculating indicators.

In our opinion, the adopted documents fully comply with the requirements of Recommendation No. 2 in terms of ensuring the availability of data required for actuarial activity and access to them by actuaries.

5. Compliance with data security requirements, compliance with legislation and national standards for the protection of data confidentiality

Recommendation No. 2 requires data security and compliance with all legal requirements for protecting the confidentiality of data.

The PFR has consolidated the implementation of this part of Recommendation No. 2, providing for the creation of an effective integrated information security system to ensure the neutralization of threats among key tasks of the AIS PFR development.

Protection of information in the AIS PFR, including its analytical module IAS, implemented in accordance with the requirements of federal legislation and national standards on information, information technology and information security, on personal data. To ensure the security of information processed by the IAS, protection measures have been chosen and implemented to ensure:

- confidentiality of information (exclusion of unauthorized access, copying, provision or dissemination of information);

- integrity of information (exclusion of undue destruction or modification of information);

- accessibility of information (exclusion of unlawful blocking of information).

Among the measures of information security implemented:

- identification and authentication of access entities and access objects;

- access control for access subjects to access objects;

- limitation of the software environment;

- protection of computer storage media;

- registration of security events;

- antivirus protection;

- intrusion detection;

- control (analysis) of information security;

- ensuring the integrity of the information system and information;

- ensuring accessibility of information;

- protection of the virtualization environment;

- protection of technical means;

- protection of the information system, its facilities, communication systems and data transmission.

Control over the implementation of these security measures is performed by the information security administrator.

6.   Ensuring the sufficiency and reliability of data

Development of data requirements

Actuarial Guidelines require that the data used by actuaries be consistent with the sufficiency and reliability criteria. Compliance with these provisions of the Actuarial Guidelines should be guaranteed by the development and documentation of data requirements (including the definition of data elements, descriptions of use and data sources).

However, Recommendation No. 2 "Data", and all other recommendations of the Actuarial Guidelines, and international standards (ISAP) of the International Actuarial Association (IAA)

contain an extremely limited list of data that should be used to generate the actuarial calculations database.

This limitation is understandable, because it is determined by the specifics of SSP in different countries and the various functions performed by the actuaries. However, it is a significant shortcoming of the Actuarial Guidelines for countries in which an effective system of actuarial activities has not yet developed, does not allow to assess the sufficiency of the information available to them by comparison with a certain standard.

In the PFR the development of data requirements has gone through several stages, as well as the formation of the database itself.

At the initial stage of creating the database of actuarial calculations, guided by common sense and information needs of the tasks of actuarial evaluation, the PFR's actuarial service specialists identified seven thematic data sets:

1. demographic indicators,

2. macroeconomic indicators,

3. Indicators characterizing the state of the labor market and the balance of labor resources,

4. indicators that characterize the age-sex distribution of insured persons,

5. indicators that characterize the volume of income of the basic, insurance and funded components of the compulsory pension insurance system,

6. indicators that characterize the obligations of the PFR to pensioners,

7. indicators that characterize the PFR's expenditures.

The first three units were filled with external data, primarily data from state statistical reporting, for which the Federal State Statistics Service (Federal State Statistics Service) is responsible.

4, 6 and 7 units are internal data of the PFR.

The 5th unit – insurance contributions and other incomes of the PFR. In the years 2000–2009, it was formed from the Federal Tax Service data, which administered social contributions for this period. In 2010–2016 years. This was the responsibility of the PFR; and, since 2017, the functions of administering social contributions have again been transferred to the Federal Tax Service.

However, having started work on the formation of the database for actuarial calculations in 2004 and determined the basic list of its thematic units, the PFR then carried out a large joint work on the inventory of the indicators with Federal State Statistics Service.

As a result of this work, the initial list of thematic units of the actuarial database was significantly expanded. A system of indicators was created in which for each indicator a section, code, name, type, unit of measure, source of information, periodicity, cut-off (list of measurements), a description of signs of cuts, and mathematical and/or logical relationships between indicators.

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The developed system of indicators fully meets the data requirements set by the ISSA-ILO Actuarial Guidelines, i.e. contains data elements, indicates the sources of data, describes the use of data (building queries, output analytical reports).

The system of indicators included 761 indicators. These indicators are classified into fourteen sections.

1. Demographic characteristics (includes 49 indicators):
   - number and structure of the population (14 indicators),
   - indicators of the natural movement of the population (14 indicators),
   - migration (12 indicators),
   - state in marriage; marriages and divorces (7 indicators),
   - structure of households (2 indicators).

2. Labor and employment (includes 73 indicators):
   - employment and unemployment (36 indicators),
   - use of working time (4 indicators),
   - strikes (4 indicators),
   - working conditions and occupational injuries (11 indicators),
   - wages and incomes from employment (8 indicators),
   - differentiation of wages (5 indicators),
   - arrears in payment of wages (5 indicators).

3. Living standards of the population (includes 93 indicators):
   - incomes, expenses and savings of the population (40 indicators),
   - macroeconomic indicators of income, consumption and savings of the household sector in the SNA (20 indicators),
   - income, available resources and their use for final consumption in private households (6 indicators),
   - property security and subjective assessments of the material situation (3 indicators),
   - income distribution and poverty (14 indicators),
   - social protection of the population (10 indicators).

4. Disability of the population (includes 15 indicators).

5. State pension provision (includes 114 indicators):

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- the number of pensioners and its distribution by types of pension provision (29 indicators),

- designated pensions (38 indicators),

- the average size of designated pensions (43 indicators),

- the main parameters of the pension provision forecast (4 indicators).

6. Execution of the budget of the Pension Fund of the Russian Federation (includes 102 indicators):

   - the budget of the PFR (49 indicators),

   - payment of pensions, social benefits for burial, monetary compensation (53 indicators).

7. Development of compulsory pension insurance (includes 33 indicators):

   - number of insured persons in the system of individual (personalized) accounting (19 indicators),

   - calculated pension capital and pension accumulations of insured persons (12 indicators)

   - pension rights of persons not registered in the system of individual (personalized) accounting (2 indicators).

8. Development of additional pensions (insurance) (includes 29 indicators):

   - number of participants in nonstate pension provision (8 indicators)

   - property and funds (11 indicators)

   - contributions in the system of nonstate pension provision (4 indicators)

   - payments in the system of non-state pension provision (6 indicators).

9. Investing of pension savings and pension reserves (includes 48 indicators):

   - investment of pension savings and pension reserves of the PFR (26 indicators)

   - investment of pension savings and pension reserves of nonstate pension funds (12 indicators)

   - performance indicators of management companies (4 indicators)

   - profitability of investments (6 indicators).

10. General economic indicators (includes 6 indicators).

11. Finances (includes 144 indicators):

    - public finance (48 indicators)

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-   financial results and solvency of organizations (29 indicators)

-   activity of insurance organizations (7 indicators)

-   monetary system (16 indicators)

-   securities market (37 indicators)

-   development of financial markets and banking sector (7 indicators).

12. Prices and tariffs (includes 8 indicators).

13. Investment activity (includes 8 indicators).

14. The main indicators of the forecast of the social and economic development of the
    Russian Federation (includes 39 indicators):

    -   general indicators (16 indicators)

    -   resources (3 indicators)

    -   use (20 indicators).

According to external indicators, dynamic series have existed since 1991, or since 2000.

The system of indicators formed by the PFR covers a much larger amount of retrospective data
than is provided for by the Actuarial Guidelines.

A wide range of indicators with the greatest possible cut-off is necessary for PFR's actuaries
because of the ongoing process of reforming the pension system, which requires an assessment
of the consequences of various measures being developed. It ensures that the data meet the
criterion of sufficiency established by Recommendation No. 2, i.e. to enable the actuary to
prepare demographic and economic assumptions, carry out the necessary actuarial calculations,
develop actuarial methodology, perform the analysis of the required indicators and compare
actual results with social goals, compare the emerging experience with actuarial assumptions,
perform any other required type of actuarial activity.

In order to ensure the adequacy of data for actuarial activities, in the Scorecard in addition to
the indicators actually existing in government or departmental statistics and databases, a
number of indicators were planned to be developed for adequate information support of
actuarial activity (so-called prospective indicators).

Most of the prospective indicators related to the internal data of the PFR are already available
in the actuarial database.

However, many promising indicators, which should have been based on data from state
statistics or other external sources (in particular, the Federal Tax Service), are still lacking.

Such promising indicators, which are extremely important for actuarial estimation of possible
reserves for ensuring the financial stability of the PFR, include, for example, the indicator of
hidden wages, which is still calculated by Federal State Statistics Service only in the country as
a whole, without the Fund for differentiation by regions and economic activities.

Another missing important most promising indicator is the distribution of the population by income level, in addition to wages. These data are contained in the information systems of the Federal Tax Service and are not yet available to the PFR.

The absence of a number of indicators of state statistics is one of the key problems of data sufficiency in implementing actuarial valuation of planned measures of pension reform.

Another problem is the discrepancy between a number of existing external indicators, the ever-expanding needs of actuarial calculations and, consequently, the need for sufficiency. In many cases, the periodicity of information collection, the cut-off of indicators, as well as the methodology for calculating them, is much narrower than necessary to assess the prospects for pension reform. For example, in the indicator "the distribution of the number of wage workers by the level of wages" (the source of information is Federal State Statistics Service), there is no information on gender and age, which is fundamentally important for the actuarial valuation of gender and age differences in the amounts of pension rights being accrued. Moreover the indicator itself is collected once every 2 years, which reduces its relevance.

To supplement government or departmental reporting with missing data (or additional dimensions), a change in the Federal Statistical Plan approved by the Government of Russia is necessary. However, due to the lack of a statutory obligation to perform an actuarial valuation of the PFR and the obligation of state bodies to provide the necessary data for this, it is difficult, if not impossible, to increase the state statistical reporting by including in it the indices necessary solely for the actuarial evaluation of the PFR.

The internal indicators of the PFR are, for the most part, consistent with the adequacy requirements reflected in the Actuarial Guidelines and the tasks of the PFR's actuarial activities. These indicators are based on methodological developments of the specialists of the Department of Actuarial Calculations and Strategic Planning of the PFR and are under their direct control.

The development of the AIS PFR and actuarial activity in the PFR system significantly expanded the Indicators system (in terms of internal indicators).

Sections No. 5 "State pension provision" and No. 7 "Development of compulsory pension insurance" of the System of indicators developed in 2004–2005, have evolved into independent systems of indicators including more detailed requirements developed specifically to meet actuarial methods of calculation and verification of data.

Instead of 147 indicators characterizing the insured persons during the formation and realization of their pension rights, as provided for in the original Indicator Scheme, information on the insured persons during their pension rights accrual period is presented in 188 multidimensional reports, each containing from 2 to 8 indicators. The total number of indicators for insured persons is 466 in all reports and 1720 in measurements (5 or more measurements in each report, although some of the measurements in the reports are repeated). The recipients of pensions and other payments are characterized by 152 measurements, 82 of which, depending on the task of actuarial calculations, can act both in the form of measurements and in the form of indicators.

Annually, the system of internal indicators is supplemented with new actuarial indicators and measurements that allow solving the tasks assigned to the PFR's actuarial service. Federal State Statistics Service and other external sources must be used in the form they are available based on the general requirements of Russian national and international statistical reporting standards.

The data requirements – the documentation required by the Actuarial Guidelines – are presented in addition to the Scorecard as a special document. This document is annually developed (updated) by the Department of Actuarial Calculations and Strategic Planning taking into account the tasks of actuarial activity and is sent to the structural subdivisions responsible for the formation of the ASAC IAS of the AIS PFR.

These requirements are included in the technical assignments for the development of the ASAC IAS of the AIS PFR and are coordinated by the heads of all structural units responsible for the formation of the corresponding information resources of the Fund.

As part of the data requirements, a list of indicators including data validation are downloaded into the modules of actuarial database. New indicators are developed every year by updating a dynamic series of previously calculated indicators. Detailed methodology and algorithms for calculating indicators, procedures for verifying the validity of downloaded data and verifying the reliability of indicators are also determined every year.

Verification procedures are included in the methodology of calculation of indicators and in the composition of monitoring reports. They are an integral part of the work following the implementation of government contracts concluded by the PFR for the development of AIS PFR and its IAS. Results are accepted by a commission consisting of accountable employees of PFR structural units.

The reports uploaded to the ASAC IAS module of the AIS PFR are subject to two stages of verification. First, an internal check is carried out: logical consistency is checked for each directory or classifier (for example, men and women in sum are given both sexes). After that an inter-report check is carried out, that is, the final values of similar reports are compared for each of the coincident sections. Inter-report verification is carried out for each year, the sign of life, the region, for all age-and-gender groups, to each of the coinciding directories or classifiers. In connection with the lack of state statistical reporting on the insured persons, reconciliation with external reporting data is not carried out.

Verification of reports on beneficiaries under construction in the ASAC FDBP module of the IAP AIS PFR is carried out by comparing them with the federal statistical observation No. 94 (PENSION). This is approved by the Federal State Statistics Service through the "Information on the number of pensioners and the amounts of pensions assigned to them," as well as with its departmental annexes developed by the PFR.

As part of the data consistency check, the reports generated in the reporting layer and in the ASAC FDBP constructor are checked for compliance with all indicators included in the statistical report (the number of recipients of all types of pensions, including those employed and appointed in the reporting year, pensions by all sources). For this purpose, the ASAC of the FDBP forms monitoring reports in accordance with the established form in accordance with the methodology of forming 94 (PENSION), loaded into test forms in the Excel environment, for which the actuary issues an opinion on the consistency of the data.

Similar checks are provided for internal reporting, formed in the PFR for other payments, other than pensions.

Thus, the PFR fulfills the requirements of Recommendation No. 2 on the development of a document that regulates the conduct of regular data verification procedures and a document that

describes the data verification procedures that allow testing of the internal sequence of data and their coherence with external sources.

Thus, the PFR fully complies with the requirements of the Actuarial Guidelines to Information Support of Actuarial Activity.

Recommendation No. 2 contains requirements for the actuary to make an opinion on the adequacy and reliability of data to assess changes in data and the consequences of using imperfect data. The actuary also makes recommendations to improve the quality of data.

However, as was repeatedly noted before, any recommendation on how to improve the adequacy and reliability of data has no practical impact because there is no legislative requirement to perform an actuarial valuation of the PFR.

Recommendations of actuaries to eliminate the problems of actuarial activity maintenance with internal data of the PFR are regularly prepared and sent to the appropriate holding units of information used in performing actuarial calculations. The internal data problems of the PFR are as follows:

- Absence of some data required by law in the AIS PFR. For example, the amount of individual pension coefficients (IPC) (previously the value of the calculated pension capital) – the indicator that determines the pension rights of the insured person is calculated individually in the personal file of the insured person upon his request. However, for analytical purposes, it is not possible to obtain information on all IPCs of all insured persons to date. Algorithms for their calculation are under development.

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- Errors in the data on the insured persons (due to incorrect data in the documents of the insured persons, incorrect filling in of the reporting forms or incorrect entry of data in the PFR information systems) that cannot be corrected without personal contact of the insured person with the PFR's client service (for example, erroneous year of birth). The amount of such errors is insignificant, but they nevertheless require correction.

- Errors in the data associated with the transition to new software. The Department of Actuarial Calculations and Strategic Planning or the actuarial calculation specialists of the PFR branches send their lists of detected errors in the internal PFR data to the heads of the units responsible for the formation of the ASAC IAS of the AIS PFR at the regional level for correction. If there is a need to fix the software, an application is created in the Technical Support System, describing the nature of the problem and the conditions for its occurrence.

However, the existing scheme of interaction when correcting errors in the data does not guarantee the correction of all errors identified by actuaries. The normative document obliging information resource holders to correct mistakes identified by actuaries in the PFR system does not exist. Currently, specialists of the actuarial service of the PFR, for their part, and the departments responsible for the formation and development of the AIS PFR, are developing proposals to create more efficient error correction processes in the PFR system.

## 7. General characteristics of the actuarial projection model of the PFR

The Fund's specialists developed the actuarial projection model of the PFR in 2000–2001. The implementation began in 2002 for the actuarial assessment of the pension reform. This was preceded by an attempt to use the projection model of an external developer (the PROST model of the World Bank). However, this model did not provide the necessary detail for the input and output indicators of Russia's pension system and the reliability of actuarial estimates of its reform. Therefore, it was decided to develop and maintain on a permanent basis its own internal actuarial projection model of the PFR.

PFR's projection model was repeatedly supplemented and modified taking into account the changes introduced into the pension and related legislation. On the basis of this, all actuarial calculations related to the forecast of the financial sustainability of the current pension system and the calculation of the economic consequences of any planned changes in the pension legislation are currently being carried out.

The decision taken by the PFR to develop its own projection model has been repeatedly confirmed by practice. Actuarial calculations for the existing SSP and proposals for its modification are actually carried out on a daily basis and the modernization of the projection model is required to ensure that all necessary external factors are taken into account. Moreover the resulting indicators are only available to the Fund's specialists who have the necessary qualifications. In addition, throughout the existing of the actuarial units in the PFR system, their experts advise external experts who have actuarial projection models of the pension system on the correctness of reflecting the norms of legislation, the correctness of calculation of pension rights and pension obligations, indexation of pensions and other issues. That once again confirms the only possible choice – the use of an internal projection model developed for the purposes of all actuarial activities in the PFR.

The entire process of development, modernization, verification and maintenance of the projection model is carried out by the Department of Actuarial Calculations and Strategic Planning of the PFR in accordance with the functions assigned to it by the Regulation on the Department approved by the Order of the Board of the PFR of August 21, 2009 No. 196r. This allows to update the pension, budget, tax and social legislation in a timely manner, as well as regularly adjusting the input of the reported and forecasted demographic, macroeconomic and other data. The projection model of the PFR and the projection methods used in it are as flexible as possible in order to ensure prompt response to the needs of customers for the results of actuarial calculations (Ministry of Labor of Russia) (Figure 7).

Figure 7. *Principles for the construction of the PFR's Actuarial Projection Model*
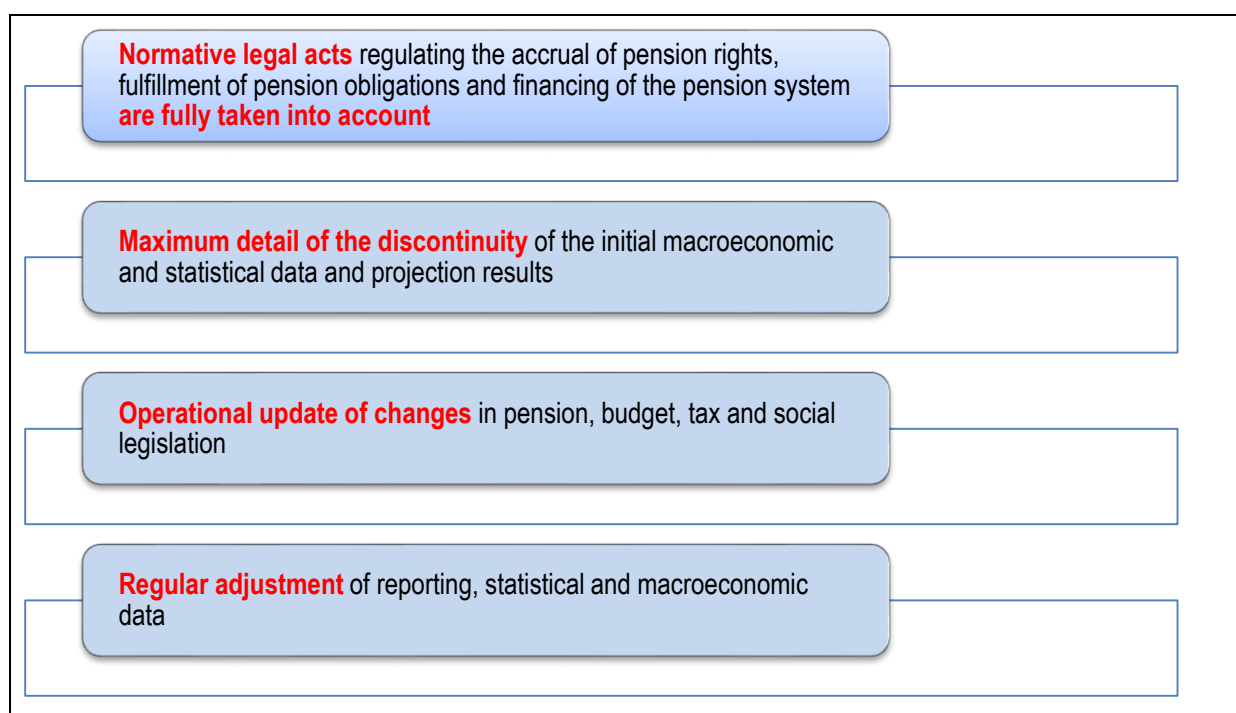
In addition to choosing the developer of the projection model for estimating the cost of the social security program, according to Recommendation No. 5, the social security institution, in consultation with the actuary, must decide on the type of the projection model (deterministic, stochastic or hybrid). Unlike the developer's choice, the PFR's decision is not documented.

The projection model of the PFR is hybrid with a predominance of deterministic approaches and individual stochastic components. This choice is directed by the actuarial valuations required by the customers (mainly the Ministry of Labor and Social Protection of the Russian Federation).The actuarial forecast calculations must take into account the smallest features of the pension system respecting rigid specified demographic and macroeconomic forecasts (taken as a basis for the development of the federal budget and strategic planning documents). The model also allows for the implementation of multivariate actuarial calculations.

To solve individual problems of actuarial calculations, micro-simulation models of individual behavior have been developed (in particular, to predict the replacement rate for a typical employee under ILO Convention (No.102) "Social Security (Minimum Standards) Convention", to study the trends of changes in various factors, to check the results use of the basic model). If it is necessary to work with them continuously, these models are built into the basic projection model of the PFR.

Projection model of the PFR meets all the requirements of the Actuarial Guidelines and allows:

- To assess the essential provisions of the social security program. The methodology takes into account all the norms of the current pension legislation: normative and legal acts regulating the accrual of pension rights, fulfilment of pension obligations and financing of the pension system in full;

- To project cash flows during the corresponding forecast period. As a rule, projection is carried out for the period up to 2030 (based on the horizon in the long-term development strategy of the pension system of the Russian Federation) or until 2050. The projection year 2050 is used in the macroeconomic projection developed by the Ministry of Economic Development of Russia and also used for budget project of the PFR for 3-year budget period and long-term perspective. However, the actuarial projection model of the PFR makes it possible, depending on the task, to carry out forecast calculations for the period 2075 or more;

- To evaluate, as appropriate, the selected measures of sustainability and adequacy. Demographic and financial components of any forecasting indicators, subject to the availability of raw data and further analysis allows us to estimate the current measures of sustainability and adequacy. More detailed analysis, such as budget deficit / surplus of each component of the pension system, the amount of the federal budget's transfer to the PFR's budget, the ratio of the average pension to the subsistence minimum pensioner or with an average salary in the housekeeper are also possible.

The PFR's projection model provides a step-by-step forecasting of:

- the population of the Russian Federation;

- the main macroeconomic indicators affecting the development of SSP;

- the number and structure of the insured persons for which insurance contributions are calculated / paid, and the recipients of pensions and other payments made through the PFR system in accordance with the legislation. Forecasting the number of participants and beneficiaries of SSP is carried out taking into account potential new participants on the open group approach;

- the revenues of the PFR budget for each SSP (and each component of the SSP) in the context of individual income items received by the Pension Fund of the Russian Federation from the insurance contributions for each payer category specified by the legislation and transfers of the federal budget;

- the expenditures of the PFR budget for each SSP (and their individual components) for each type of pensions (other payments) based on an assessment of the amount of pension rights of insured persons and the state-defined pension obligations of the state represented by the PFR. The evaluation of the volume of pension obligations is carried out on the basis of information of the database of actuarial calculations;

- the balance of incomes and expenditures of the PFR budget, the pension system's burden on the federal budget and the degree of dependence of the budget on federal budget transfers, the level of retirement provision of various categories of beneficiaries, indicators characterizing the achievement targets for the development of the pension system established by strategic documents.

The calculations carried out in the projection model are based on a thorough analysis by the PFR of the historical trends in the changes of factors affecting the development of the pension system and the development of assumptions about their further change and the impact on the budget of the PFR and the level of pensions. Responsibility for the analysis and the development of assumptions is fully entrusted to the Department of Actuarial Calculations and Strategic

Planning. Scenario conditions for calculations and assumptions, if necessary (when actuarial calculations are performed to assess the impact of measures to modify the pension system, proposed by external organizations – ministries, departments, experts and expert communities) are agreed with parties concerned.

The PFR projection model consists of three units: demographic, macroeconomic and financial.

8. The demographic unit of the PFR projection model

The demographic unit of the projection model of the PFR allows to develop a demographic projection both with the retention of the existing normative retirement age and with the condition that it is increased separately for men and women at different times and with varying rates of change.

The demographic projection developed in the demographic unit of the PFR projection model includes forecasts for:

- the population of the Russian Federation;

- insured persons forming pension rights (i.e., employed in the economy and paying insurance premiums);

- recipients of pensions and other payments from the PFR.

If the long-term population projection is developed by Federal State Statistics Service, it is used as input for the development of the remaining components of the demographic forecast.

The demographic unit of the PFR's projection model includes three interrelated units: baseline data and scenario conditions, projection and results.

The initial data unit prepares the initial data for projection, and also determines the scenario conditions.

The initial data includes data from the state statistical reporting on:

- the distribution of the number of the population, the number of births and deaths, and the number of migrants (emigrants / immigrants) by one-year age and sex groups;

- general and age-specific fertility rates, general and age-specific mortality rates for men and women, life expectancy, and demographic aging rates

The initial data are also used for retrospective data of PFR's departmental reporting. This data is also loaded into the database of actuarial calculations on the age-sex distribution of the number of live and deceased insured persons during their employment and payment of contributions. This information is available for more than twenty categories defined by law with specific insurance contributions. It is also available during the period of receiving pensions or other payments from the PFR (for all main types of pensions, by types of early insurance pensions for old age – in aggregate also more than 20 categories) and for all types of other payments.

All units of the projection model included calculation methods for all laws effective since 2002. Therefore it allows the PFR's actuaries to return to previous forecasting in the context of the pre-existing categories (if statistical reporting allows this).

Depending on the task assigned to the PFR's actuaries, the initial data on the insured persons engaged in labor activity may be differentiated by economic activity or not.

The initial data on the number of recipients of payments, in addition to the cut-off by sex, age, types and grounds of pensions and other payments, are loaded into the demographic unit in the sections:

- new appointments (appointed in the reporting year) that survived to the year of the forecast from previous years of appointment (for each of the previous years) and all (the appointment of all years);

- working, unemployed, total.

As scenario conditions, vectors of change (for one-year age and sex groups) are formed for the birth rate, death rate (in the absence of the Federal State Statistics Service population projection), employment and employment levels in the relevant categories, unemployment, the probability of becoming and being a pensioner / recipient of another payment.

The initial development scenario corresponds to vectors containing the values of these indicators by the reporting year. For more optimistic scenarios, change vectors are used that reflect the targets set by the strategic documents of the country's development. In particular, to predict the changes in the demographic situation, the guidelines of the Concept of the Demographic Policy of the Russian Federation adopted in 2007 for the period up to 2025 can be used, providing for[3]:

- increasing life expectancy to 75 years;

- increasing by 1.5 times the total fertility rate in comparison with 2006;

- reducing 1.6 times the death rate in comparison with 2006;

- ensuring a migration increase of more than 300 thousand people annually.

Calculations of the prospective population, insured persons, recipients of pensions and other payments are made using the component method. When predicting the number of insured persons, the matrix of labor activity, the number of recipients of pensions and other payments are used-matrices of new appointments for each category of recipients. The categories of insured persons (employed or receiving pensions / other payments) fully correspond to the categories in the source data, unless other differentiation (more narrow or changed) is required by the conditions set for the PFR's actuaries.

The results of demographic projections are presented by gender and by one-year age groups:

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[3] Decree of the President of the Russian Federation of 09.10.2007 N 1351 (as amended on 01.07.2014) "On the approval of the Concept of the demographic policy of the Russian Federation for the period until 2025".

- distribution of the population, including separately the number of migrants (provided that a demographic projection is constructed in the absence of a Federal State Statistics Service population forecast);

- tables of mortality and life expectancy for the population; mortality rates for forecasting the number of disabled people (they are developed by PFR specialists if Federal State Statistics Service population forecast does not exists);

- fertility tables (are developed by the PFR specialists if demographic projection of Federal State Statistics Service does not exist);

- level of demographic aging;

- Distribution of deaths (for the population, for the insured, for pensioners and recipients of other payments for each category);

- distribution of the number of insured persons for whom contributions are paid in the main categories, by categories with a reduced rate of insurance contributions and by categories giving the right to early retirement (based on the tariffs established for them);

- distribution of the number of recipients of the insurance pension by types of insurance pension, by the year of the pension and the indication of employment;

- distribution of the number of recipients of an old-age insurance pension on the grounds of early retirement pensions and on the year of appointment of a pension;

- distribution of the number of recipients of a funded pension by the year of the appointment of a pension;

- distribution of the number of recipients of other payments for each type of payment (total and for new appointments).

The resulting indicators of the demographic unit are the initial data for the financial unit of the projection model of the PFR.

9. Macroeconomic unit of the projection model of the PFR

The PFR's actuaries are not responsible of the long-term projections of the socioeconomic development of the Russian Federation, since it belongs to the competence of the Ministry of Economic Development of Russia.

However, the Ministry of Economic Development of Russia develop long-term macroeconomic forecasts less often than medium-term ones used to do the budget of the PFR and the federal budget.

During the preparation of the budget, the Ministry of Economic Development of Russia may adjust several times the macro-projection parameters for the medium term (3 years) without updating the long-term macro-projection.

During this period, it is necessary to extend the horizon of the medium-term projection for the development of long-term projections for pensions and the budget of the PFR for the Fund's actuaries. Such an extension is carried out by maintaining the relative values of the change in

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the indicators contained in the long-term macro-projection and recalculating the absolute
values, taking them into account and taking into account the indicators of the new medium-
term projection.

 The macroeconomic unit of the PFR's projection model accomplishes this task. The same
module can be used to develop multi-variant long-term macroeconomic projections by actuaries
of the PFR, intended for use in assessing the prospects for the development of the pension
system under various macroeconomic conditions.

Stages of developing a long-term macroeconomic projection:

- Formation of initial data;

- selection of the modeling scenario: high, medium, low;

- long-term projection of the main indicators of the social and economic development of
  the Russian Federation (Figure 8).

Figure 8. *Stages of macroeconomic modelling*
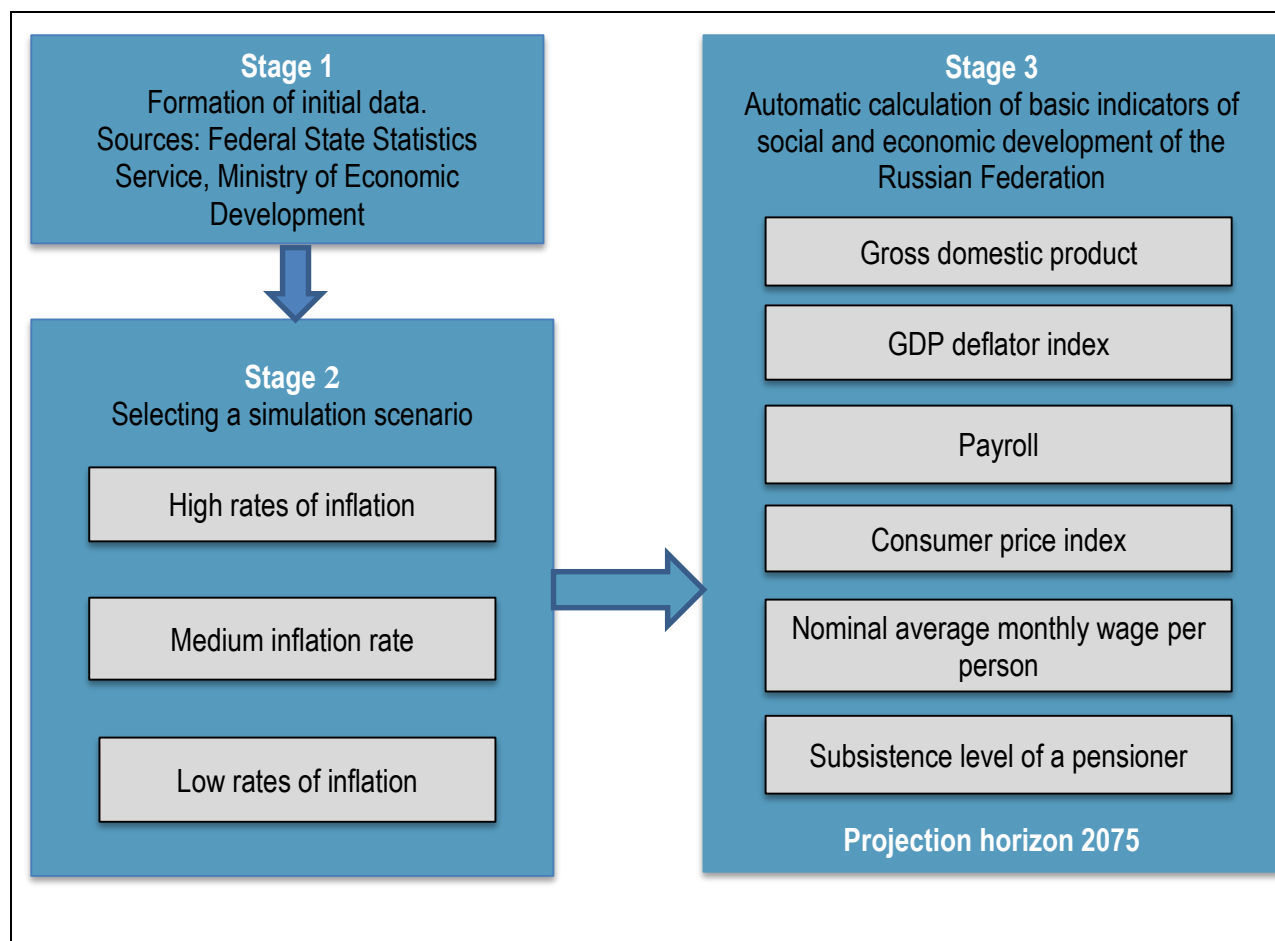
The initial data of the macroeconomic unit of the PFR projection model are: gross domestic
product, labor productivity, payroll, average monthly nominal accrued wages per employee and
the differentiation of workers in terms of wages. It also includes minimum wage, subsistence
minimum of the working population and pensioners, and the growth rates of these indicators,

the consumer price index (on average for the year and from December to December), the GDP deflator index and the share of the payroll in GDP, return on investment pension savings. Each parameter us is projected over the long-term. Projections are available in current prices, in base year prices and in prices of the previous year.

Within the framework of the macroeconomic unit, it is also possible to have scenarios where the tariffs of insurance contributions to the Pension Fund are changed for the purpose of compulsory pension insurance. In scenario conditions, the following are set:

- the number of income groups for which different tariffs are set;

- rules for changing (indexing) the values of the boundaries of income groups, for which different tariffs are set;

- tariffs of insurance premiums for various income groups for the main categories of insured persons;

- the ratio of the collection of insurance contributions to the insurance pension (separately for the individual and solidarity parts of the tariff) and to the funded pension.

Taking into account the given scenarios of the tariff policy and the forecasted values of the CPI calculated in the macroeconomic unit and the growth rates of the average wage in the economy, the values of the income group boundaries are estimated to collect insurance contributions, including the maximum (maximum) border of the assessment base.

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Tariffs of insurance contributions are established for three generations of insured persons: young, middle and senior. The young are those born in 1967 and years thereafter. The middle-aged are the men born from 1953 to 1966 and the women from 1957 to 1966. Lastly the elders are men born in 1952 and before and women born in 1956 and before. This breakdown is due to the terms of the pension reform of 2002, which provided for restrictions on participation in the formation of pension savings and different rates of insurance contributions for the accumulation, depending on the year of birth of the insured person.

The model provides for the possibility of establishing progressive or regressive tariff scale, as well as their combinations for different income levels.

The establishment of tariffs for insurance contributions in the macroeconomic unit of the projection model is provided separately for each of the four main categories of insured persons, the number of which is projected in the demographic unit (2 categories of employees, individual entrepreneurs, lawyers). Such a breakdown of the insured into the main categories was provided for by the 2002 pension reform.

However, at present, the macroeconomic module sets scenario conditions for tariffs only for the two main categories of employees (employees, except those engaged in the production of agricultural products and for hired workers engaged in the production of agricultural products).

Scenario conditions for tariffs for individual entrepreneurs and lawyers, as well as for another 20 categories appearing in the legislation in different years, for which a reduced rate of insurance contributions is paid causing falling revenues of the PFR budget that are reimbursed by the federal budget, are now set directly in the financial unit of the projection model. The macroeconomic unit retains the possibility of returning to the formation of scenario conditions

for tariffs of insurance contributions for the initial structure of payers (which includes four main categories, without categories covered by a reduced tariff).

At the final stage, scenario conditions are set in terms of differentiating the main categories of insured persons into 20–25 payroll groups (preservation of the existing structure or vectors of its change). Taking into account these scenarios, an annual payroll fund projected for one employee in each group, a wage fund for the entire group, a fund assessed at each rate and a non-taxable fund are determined.

10. Financial unit of the PFR projection model

The financial unit provides for a consistent projection of revenues, expenditures and the budget balance of the PFR (Figure 9). Just like the demographic unit, the financial unit ensures the development of forecasts in the conditions of the existing normative retirement age and under different scenarios for its increase.

Figure 9. *Structure of the financial unit of the PFR's Actuarial Projection Model*

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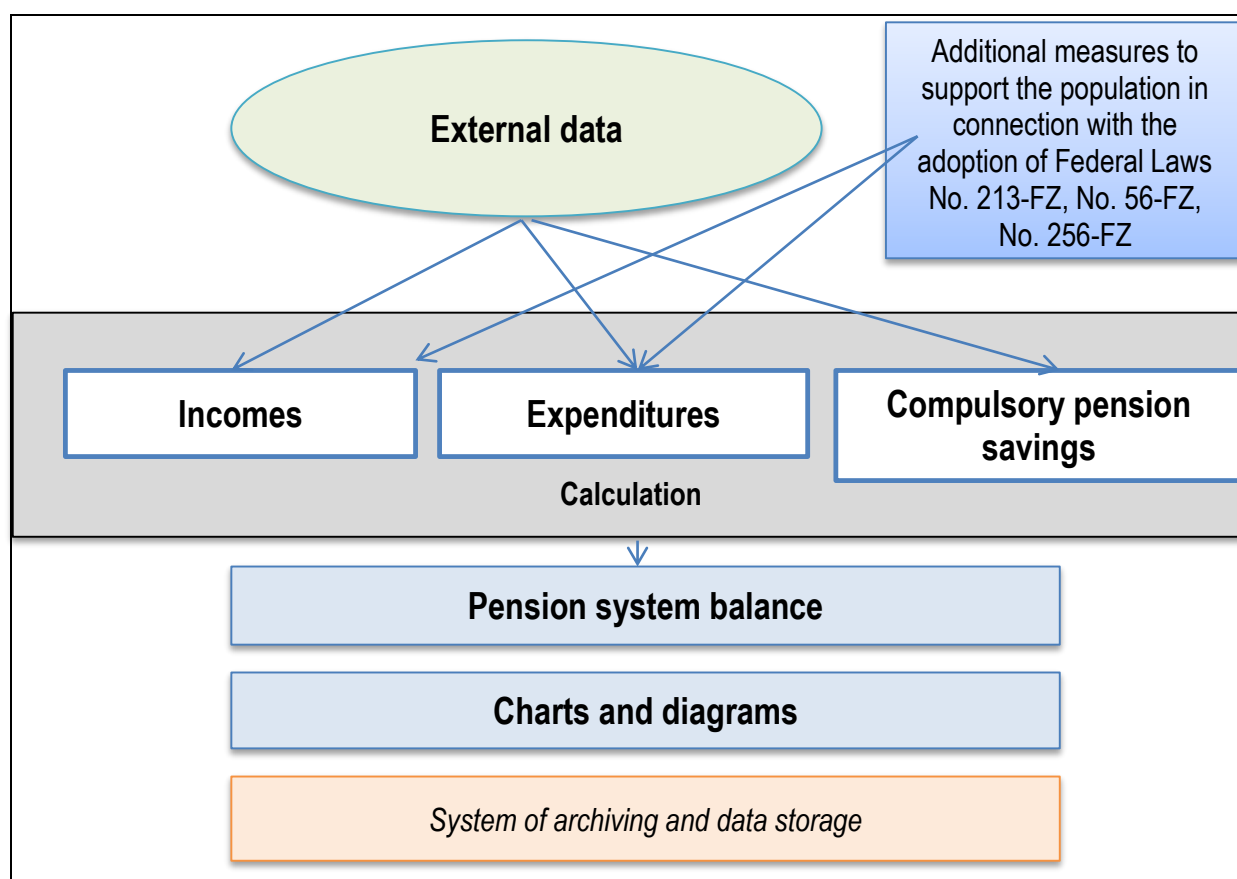
The initial data and scenario conditions for calculating revenues and expenditures are used in the financial unit. The resulting indicators of the demographic and macroeconomic units of the PFR projection model and the current pension legislation are also used. The current pension legislation includes the conditions for the appointment and payment of pensions and other payments, the conditions for the formation of pension rights of insured persons, the conditions for converting paid contributions to pension obligations, the indexation rules, etc.

To assess the consequences of implementing the proposed measures for the further reform of the pension system, specialists of the PFR's actuarial service perform a mathematical interpretation of each measure. In addition, for each measure, scenarios for actuarial calculations are developed and agreed with the interested parties who are the developers of the respective measures.

The initial data on pension rights and obligations, the data of the departmental reporting of the PFR and the data on the age-sex distribution of the number of live and deceased insured persons over the one-year intervals of the length of service (insurance and special) are applied to periods of operation under various pension laws. The amount of accrued and paid insurance contributions and the types and amounts of pensions and other payments (for persons to whom they are appointed) are also used.

The model maintains a financial history of pension rights and liabilities in the CPI system since 2002. This projected data are converted into the reporting ones and are compared with the statistical reporting and data of the actuarial database. They are stored in the model for the development of long-term projections.

In the absence of the necessary data in departmental statistics or the database of the actuarial database (for example, after switching from one pension formula to another), long-term projections are based on historical estimates over the past periods. Such assessments are made according to the amount of pension rights created by the insurance pension that is, by the amounts of individual pension coefficients formed during the existing periods of various pension laws, i.e. until 1991, from 1991 to 2001, from 2002 to 2009, from 2010 to 2014 and from 2015.

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In the financial unit of the model, when calculating the revenues of the budget of the PFR, scenario conditions are set for the tariffs of insurance contributions and the income lines to which contributions are charged for individual entrepreneurs, lawyers and the categories of payers that are equal to them, as well as for categories that are legislatively set to a reduced tariff of insurance contributions, such as:

- economic societies, established budgetary scientific institutions and educational institutions of higher professional education;

- organizations and individual entrepreneurs applying a simplified taxation system and carrying out economic activities for which a reduced tariff is set, etc.

Based on the output data and scenario conditions of the demographic and macroeconomic units, as well as the scenario conditions specified in the financial unit, the calculation of the receipt of insurance contributions is made:

- on an insurance pension;

- for a fixed payment to an insurance pension;

- on a funded pension.

Projections of insurance contributions are made for three generations of insured persons (young, middle, old) for the main categories, as well as categories for which a reduced tariff is paid.

Insurance contributions for the categories of persons for whom a reduced tariff is paid are calculated under two options – at a full rate and at a reduced rate. The difference between them corresponds to the necessary value of the transfer of the federal budget to the PFR's budget to cover the so-called drop-outs.

The income unit includes projection of transfers of the federal budget also for valorization, financing of non-insurance periods of experience, etc., as well as for compulsory pension insurance system, including covering the budget deficit of the PFR within the framework of the federal budget's subsidiary responsibility (Table 1).

Objects of the unit "Incomes" of the Financial Model of the PFR:

- income for financing a fixed payment to an insurance pension, an insurance pension, and a funded pension;

- sources of financing;

- distribution of insured persons by categories of employees (depending on the tariff of insurance premiums) and age (years of birth: 1967 and younger, 1966-1953, 1952 and older);

- the system of tariffs for insurance contributions;

- effective tariff;

- the system of privileges for certain categories of insured persons on the formation of pension rights.

Table 1. *Basic and variable indicators of the "Incomes" unit*

| Basic indicators	Variable indicators
Output information from the Demographic Model of the PFR in terms of the number and age and sex structure of the insured	Macroeconomic indicators for the period of three-year budget planning and long-term perspective
Retrospective macroeconomic indicators of the development of the Russian Federation since 2002	Distribution of the number of insured persons by groups of wages
Retrospective parameters of tax legislation (social rates, insurance contribution rate, minimum fixed payment amount, tax base boundaries, retrospective data on the level of collection of social tax)	Limits of the tax base
	The level of collection of insurance contributions
	Period of payment of contributions for insured persons (length of service of insured persons and retirement age)

At the last stage of income projection, their summary is included in the enlarged income items composed of actuarial calculations to the client i.e. the PFR's leadership or the Ministry of Labor). The calculation of the effective tariff of insurance contributions, defined as the ratio of insurance contributions to the value of the wage fund are also presented.

Projection of expenditures (Figure 10) is carried out separately for each type of pension (old age, disability and loss of the breadwinner), as well as for the main categories of early retirement pensions.

At the initial stage of projection, scenarios are set for the specific weight in the total expenditures of the following types of expenditure: on the up-rate of pensions, on financial and logistical support for the current activities of the PFR and its territorial bodies.

Then, based on projection of the CPI in each year of the projection period, it is projected in the monthly and quarterly and semi-annual types to determine the timing of the indexation of the insurance pension and the fixed base size of the insurance pension associated with the growth of consumer prices.

Figure 10. *"Expenditures" unit*
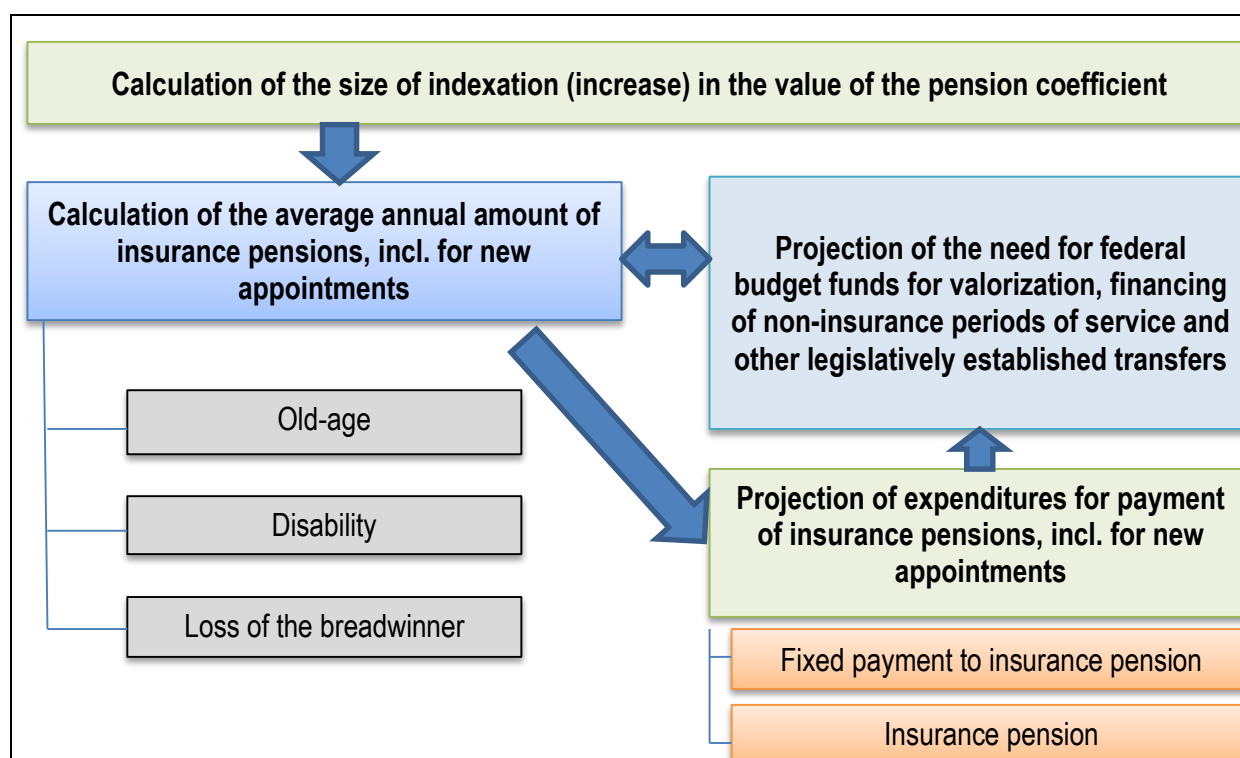
The next step is to determine the date and size of the so-called pre-de-pensionation (that is, indexation in excess of inflation), or based on the growth of the salary and income of the Pension Fund (per pensioner) – the value of one pension coefficient based on the total amount of individual pension coefficients available to pensioners. This mechanism is determined by the current legislation.

The model preserves the various formulas of indexation applied in the period from 2002 and the calculations made on them and allows in any year of the projection period to return from the current indexing mechanism to the existing one.

Indexation rates projection is the basis for expenditures projection for the payment of pensions.

Expenditures projection for payment of pensions for old age, disability and on the occasion of loss of a bread-winner is carried out according to a standard scheme, with all differences in the mechanisms for calculating pensions of each type are taken into account.

The calculation is based on data on the distribution of the number of each category of recipients of the pension by the length of the insurance period.

Initially, when the projection model was formed under the conditions of the pension legislation, which began operating in 2002, it was envisaged to divide the pensioners into two groups: "old" (retired before 01.01.2002), and "new" (retired after the beginning of the pension reform).

This division was due to the lack of sufficient data on the differentiation of retired people before 2002 in terms of length of service and the size of pensions. Therefore, the averages were taken into account in the model. In the process of developing the database, the problem of lack of information on "old" pensioners was eliminated, but the available level of reliability of projection expenditures by average for "old" pensioners allowed to make a decision to preserve the initial approaches to projection.

Expenses for the payment of pensions to "new" pensioners are calculated in the model in more detail – separately for each year of the appointment of pensions, i.e. for those who retired in 2002, in 2003, in 2004, etc. These pensioners in each year of destination differentiate according to the level of pensions by 20–25 groups, by analogy with the differentiation of the wages of insured persons paying contributions.

This approach allows to construct a single profile of the income of the insured person in the working and pension periods and provides a convenient opportunity to analyze the impact of the level of income during the period of work on the level of pensions. In addition, it provides the ability to automatically calculate the number of insured persons who do not gain the required number of individual pension coefficients and therefore will not be able to claim an insurance pension.

In addition, the history of pension rights is maintained differentially, depending on the period of their formation (with different pension laws and formulas):

- conversion of pension rights earned before 01.01.2002;

- valorization of pension rights earned for the period up to 1991;

- rights, formed from 01.01.2002 to 31.12.2014 by the formula of conditional-accumulative capital;

- rights, formed from 01.01.2015 to the present time by the formula of the Federal Law on Insurance Pensions.

The PFR projection model includes the cancellation since 2016 of indexation of pensions to insured persons who continue working activity for the period before its termination. The projection model allows separate calculations of all characteristics of working pensioners. For example, the duration of work after the appointment of a pension, contributions paid during the period of work after the appointment of a pension and the pension rights purchased from paid contributions after the appointment of a pension are calculated. The financial stability of the funded component is projected separately from the distributive component in the special module "Accumulation". It predicts incomes and expenses for the funded composition of the

groups of salaries of insured persons similar to the groups used to calculate pension rights and obligations under an insurance pension. Projection of incomes, pension rights of insured persons and obligations of the insurer in the funded component includes the following steps:
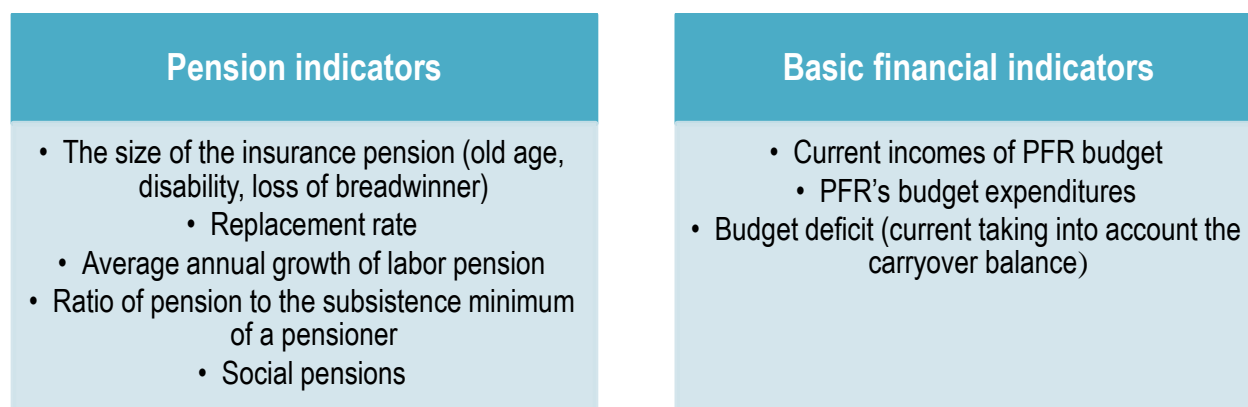
1. forecast of annual receipts of insurance contributions on the accumulative component with the distribution between the PFR and non-state pension funds (NPF), depending on the choice of the insured person.

2. forecast income from temporary placement of insurance contributions to the formation of funded pension;

3. forecast of the structure and volumes of transfer of funds between the PFR and NPF;

4. forecast of profitability of pension savings of investment portfolios, formed in the state management company;

5. forecast of the volume of the formed pension savings;

6. forecast of the obligations of the PFR for the funded component;

7. Balance forecast for the funded component.

The methodology used for projection is similar to that used up to 2015 for an insurance pension when the calculations of pension rights and obligations were made on the basis of a conditional-savings account scheme. The difference is in the application of a non-conditional coefficient of indexation of pension rights, and the forecast values of return on investment. Since the PFRs actuaries do not have the power to participate in determining the policy of investing pension savings funds (it is determined by law), the profitability in the PFR model is projected solely on the basis of past trends.

The model also calculates federal budget funds for benefits other than pensions: maternity (family) capital, voluntary co-financing of insurance contributions to a funded pension, and so on.

Based on the results of the actuarial calculations, the model forms the balance of the budget of the PFR, which includes three groups of resulting indicators: macroeconomic indicators (reference), pension indicators and financial indicators (Figure 11).

Figure 11. *Actuarial balance of the PFR system*

Pension indicators	Basic financial indicators
• The size of the insurance pension (old age, disability, loss of breadwinner) • Replacement rate • Average annual growth of labor pension • Ratio of pension to the subsistence minimum of a pensioner • Social pensions	• Current incomes of PFR budget • PFR's budget expenditures • Budget deficit (current taking into account the carryover balance)

The resulting macroeconomic indicators include: GDP, payroll, average monthly nominal wage, CPI, the subsistence minimum of the pensioner, number of employees.

The resulting pension indicators in the standard scheme for presenting the results of the actuarial valuation of the PFR include:

- number of recipients of pensions;

- the size of indexation of pensions;

- cost of one pension coefficient;

- the average size of a fixed payment to the insurance pension and the actual insurance pension (old age, disability, on the occasion losses of the breadwinner), accumulative pensions, social pensions, as well as similar pensions for persons to whom they were appointed in the reporting year (pensions for new appointments);

- the ratio of pensions to subsistence minimum of the pensioner;

- the replacement ratio (the ratio of the average size of the corresponding pension to the average wage in the economy);

- the comparison of the average size of pensions, the rates of their growth, the rate with the subsistence minimum of the pensioner and the average wage in the economy for working and nonworking pensioners;

- the amount of federal social subsidies to the subsistence minimum of the pensioner (in the regional context);

- effective tariff on the distribution and accumulation system components of compulsory pension insurance system.

Financial results are presented in absolute terms, and in per cent of GDP separately for the distribution and the funded component of the pension system. The standard resulting financial indicators presented on the basis of the results of actuarial calculations in the PFR projection model include:

- the current revenues of the PFR budget, including insurance contributions and transfers of the federal budget to the PFR budget;

- the expenditures of the PFR budget, including expenses for payment of insurance pension, to burial dead pensioners, to ensure the activities of the Fund and its territorial bodies and budget investments in the capital construction projects of the PFR;

- budget deficit (current taking into account the carryover balance).

To conduct the assessment of raising the retirement age in the PFR projection model, the change in the number of insured persons for whom contributions are paid is necessary and must take into account the maximum possible increase in the employment rate in the age groups falling under this increase (to the level of employment at pre-retirement ages). Raising retirement age also impacts employment in youth ages, the disability incidence rate, the duration of the insurance period and the size of the wage fund. It also impacts the macroeconomic situation in

the country by reducing the number of old-age pensioners and changing the indexation of designated pensions and other factors.

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