Model to Formation Data Base of Internal Parameters for Assessing the Status of the State Secret Protection

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Abstract

Protection of information with limited access, especially state secrets, is an important task in the sphere of national and information security of the state. To minimize the possible damage to the national security of Ukraine from violations in the sphere of protection of state secrets) and to reduce the negative international rating and other serious consequences at the state level, the task of creating specialized databases, and developing and improving existing methods and models that implement relevant assessments is urgent. That is why, the theoretical-multiple presentation of the parameters of the generalized report and the report on the state of state secret protection in tuple models allow solving the actual scientific and practical task of formalizing the process of assessing the negative consequences of leaking a state secret, its disclosure or loss of material carriers of secret information, violation of the secrecy regime, etc. Previously, a tuple model of primary parameters was developed, and currently, as its continuation, a model of internal parameters and its hierarchical structure has already been proposed, due to the integrated theoretical-multiple representation of sets characterizing the information about the availability of the employees of the reporting subject of admission and access to of state secrets and the number of material carriers of secret information, allows, under the requirements of current legislation, to determine a set of input and output parameters for the formation of special databases and the formalization of the process of assessing the damage caused to national security from the leakage of state secrets. In the future, to implement the above-mentioned process, it is necessary to develop an appropriate model of formalization and processing of the database of secondary parameters of the subject of regime-secret activity.

Keywords

Information protection, limited access, state secret protection, parameter model.

1. Introduction

According to requirements [1], the information constituting a State Secret (SS) in the field of defense [2], economy, science and technology, foreign relations, state security [3, 4], and law enforcement is subject to state protection [5], if their disclosure could harm the national security of Ukraine. According to the procedure for assigning information to the SS [1], the State Expert on Secrets issues (SES) decides to assign a category of information or individual information to the SS with the establishment of their Degree of Secrecy (DS) by substantiating and determining the amount of possible damage to the national security of Ukraine in the event of disclosure of these

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information, with their subsequent inclusion in the "Compendium of information constituting a state secret" [6] (hereinafter—CISS). It remains the only theoretical mechanism for determining the parameters of possible harm is the "Methodological recommendations to state experts on secrets on determining the grounds for classifying information as a state secret and the degree of their secrecy" [7] (hereinafter—Methodological recommendations), its detailed analysis, description of problematic issues and individual studies are given in [8, 9]. Taking into account the absence of any other methods of its calculation, the "Method of analysis and assessment of the amount of possible damage to the national security of the state in the field of protection of state secrets" (hereinafter—the Method) [10] was developed, which, due to the basic model of the integrated representation of damage parameters and logical linguistic approach in the processing of dynamically changing sets of identifying and evaluation parameters calculates indicators of economic damage and other serious consequences, which made it possible to determine the amount of possible damage to national security in case of disclosure of DT or loss of Material Carriers of Classified Information (MCCI). The method is based on the main provisions of Methodological recommendations [7], CISS [6], criteria for determining possible damage to the national security of Ukraine in case of disclosure of information protected by the state, and methods of evaluating the effectiveness of the SS Protection System (PSS) [8–13], as well as statistical data of the "Report on the state of ensuring the protection of SS" (hereinafter—the Report) [14].

The number of violations related to treason and/or sabotage, in terms of loss, disclosure, or transfer to a foreign country of information constituting SS, is significantly increasing both in the world [15] and in Ukraine [16]. This process has been intensified since 2014, after the occupation of certain territories of Ukraine (Donetsk and Luhansk regions, Autonomous Republic of Crimea). At that time, to strengthen the national security of Ukraine in the field of PSS, the decisions of the NSDC "On additional measures to strengthen the national security of Ukraine" and "On the state of overcoming the negative consequences caused by the loss of material carriers of classified information in the temporarily occupied territory of Ukraine, in the area conducting an anti-terrorist operation in the Donetsk and Luhansk regions", which introduced criteria for the classification, assessment, and identification of levels of terrorist threats, determination of a complex of measures for the prevention, response, and termination of terrorist acts, taking into account these levels, the establishment of regimes of control, protection, and protection of objects of possible terrorist encroachments depending on the object category. Also since 2015, and already in 2020, changes were made to the Report, which was supplemented with dynamically changing sets of identifying and evaluation parameters for ensuring the state of PSS, which in one way or another makes corrections and additions to the model [13] with the need for further improvement Method [10], including and using a theoretical-multiple approach to assessing damage to the national security of Ukraine in the event of a leak of information constituting SS [17], as a continuation of the development of a model for the formation of a database of parameters for assessing the state of state secret protection in Ukraine [18].

2. Formulation of the Problem

To minimize the possible damage to national security from violations in the field of PSS and reduce the negative rating at the state level, it is necessary to create databases, methods, and models that implement appropriate assessments. That is why, the theoretical-multiple presentation of the parameters of the "Generalized report on the state of security of SS" [14] (hereinafter—the Generalized report) at the state level and the Report at the level of a separate Subject of Regime-Secret Activity (SRSA) and Regime-Secret Department (RSD), generalized by tuple model is an actual scientific task, which allows solving the scientific and practical task of forming a database of parameters of the state of PSS for further creation of the necessary statistical data and formalization of the process of assessing the negative consequences of the leakage of SS, caused by their loss or disclosure.

In this regard, *the purpose of this article* is to develop a model for the formation of a database of internal parameters for assessing the state of the provision of PSS from the use of identification, static, and other data regarding the negative consequences (damage) in the event of a leak of SS in violation of the requirements of PSS established by law.

3. Continuation of Model Development

One will use the set of all possible identifiers of IS (*Information about the Subject*) tuples, which can be used to display information about SRSA and be used in the process of detecting and assessing the consequences in case of loss of SS [19, 20]:

$$\mathrm{IS} = \{\bigcup_{\varphi=1}^{z} \mathrm{IS}^{\varphi}\} = \{\mathrm{IS}^{1}, \mathrm{IS}^{2}, \ldots, \mathrm{IS}^{z}\}, \qquad (1)$$

where $\mathbf{IS}^{\varphi} \subseteq \mathbf{IS}$ $(\varphi = \overline{1,z})$ is the identifier of the tuple of parameters characterizing the φ[th] SRSA.

For example, at z=4 (1) will have the form [19]:

$$\mathbf{IS} = \left\{\bigcup_{\varphi=1}^{4} IS^{\varphi}\right\} = \{\mathbf{IS}^{1}, \mathbf{IS}^{2}, \mathbf{IS}^{3}, \mathbf{IS}^{4}\} = \\ = \{\mathbf{IS}^{\mathrm{NAU}}, \mathbf{IS}^{\mathrm{ZhVI}}, \mathbf{IS}^{\mathrm{NA\ SBU}}, \mathbf{IS}^{\mathrm{SI\ "SSI"}}\}$$

where $\mathbf{IS}^{1} = \mathbf{IS}^{\mathrm{NAU}}$, $\mathbf{IS}^{2} = \mathbf{IS}^{ZhVI}$, $\mathbf{IS}^{3} = \mathbf{IS}^{\mathrm{NA\ SBU}}$, $\mathbf{IS}^{4} = \mathbf{IS}^{\mathrm{SI\ "SSI"}}$ respectively, the identifiers of the convoys of the SRSA **"National Aviation University" (NAU), "Zhytomyr Military Institute named after S. P. Korolev" (ZhVI), "National Academy of the Security Service of Ukraine" (NA SBU), State institution "Sumy investigative detention center" (SI "SSI").**

For the φ-th SRSA, the tuple of parameters characterizing it has the following form:

$$\mathbf{IS}^{\varphi} = \left\langle \mathbf{IS}^{\varphi_1}, \mathbf{IS}^{\varphi_2}, \ldots, \mathbf{IS}^{\varphi_i}, \ldots, \mathbf{IS}^{\varphi_k} \right\rangle \qquad (2)$$

where: $\mathbf{IS}^{\varphi_i} \subseteq \mathbf{IS}^{\varphi}$ $(i = \overline{1,k})$ is a component of the tuple, which is a subtuple and displays the i[th] parameter identifier of the φ-th SRSA, and k is the maximum number of such parameters. Note that all members are characterized by the property of order.

For example, according to the Generalized Report and the Report [14], we define tuple (2) as:

$$\mathbf{IS}^{\varphi} = \left\langle \mathbf{IS}^{\varphi_1}, \mathbf{IS}^{\varphi_2}, \mathbf{IS}^{\varphi_3}, \mathbf{IS}^{\varphi_4}, \mathbf{IS}^{\varphi_5}, \mathbf{IS}^{\varphi_6}, \mathbf{IS}^{\varphi_7}, \mathbf{IS}^{\varphi_8}, \mathbf{IS}^{\varphi_9} \right\rangle$$

where, for example, subtuple $\mathbf{IS}^{\varphi_1}$ **= Section 1** ("Information about SRSA, it's subordination and departmental affiliation"), and other components are indicated in Table 1. Let's divide the components $\mathbf{IS}^{\varphi}$ of this table. 1 by types of parameters on primary, internal, and secondary.

The first group of (primary) parameters is discussed in detail in the scientific work [18], and therefore we will describe the following second group of (internal) parameters $\mathbf{IS}^{\varphi_3}$ and $\mathbf{IS}^{\varphi_4}$.

Table 1

An example of a component description $\mathbf{IS}^{\varphi}$

Type of parameters	$\mathbf{IS}^{\varphi_i}$	Symbolic designation	Description $\mathbf{IS}^{\varphi}$
primary	$\mathbf{IS}^{\varphi_1}$	**Section 1**	Information about the subject of reporting, his subordination, and departmental affiliation
	$\mathbf{IS}^{\varphi_2}$	**Section 2**	Information about RSD, financing of activities with PSS
internal	$\mathbf{IS}^{\varphi_3}$	**Section 3**	Information on whether employees of the reporting entity have permission and access to state secrets
	$\mathbf{IS}^{\varphi_4}$	**Section 4**	Information on the number of material carriers of classified information
secondary	$\mathbf{IS}^{\varphi_5}$	**Section 5**	Information on the performance (scientific and/or scientific and technical support) of secret research, development, design, and other scientific works, the manufacture of secret products
	$\mathbf{IS}^{\varphi_6}$	**Section 5(A)**	Information regarding the order (scientific and/or scientific and technical support) of secret scientific research, research and development, design and other scientific works, production of secret products
	$\mathbf{IS}^{\varphi_7}$	**Section 6**	Information about regime premises, objects of information activity
	$\mathbf{IS}^{\varphi_8}$	**Section 7**	Information on the facts of MCCI losses or the disclosure of information constituting a state secret, as well as information with limited access to foreign countries or international organizations
	$\mathbf{IS}^{\varphi_9}$	**Section 8**	Information on international cooperation

The third component of the subtuple $\mathbf{IS}^{\varphi_3}$ **= Section 3 ("Information on whether the employees of the reporting entity have permission and access to state secrets")** is filled in by the SRSA as of the end of the reporting period by filling in the corresponding columns (parameters):

$$\mathbf{IS}^{\varphi}{}_3 = \left\langle \mathbf{IS}^{\varphi}{}_{3.1}, \mathbf{IS}^{\varphi}{}_{3.2}, ..., \mathbf{IS}^{\varphi}{}_{3.i}, ..., \mathbf{IS}^{\varphi}{}_{3.q} \right\rangle, \quad (3)$$

where $\mathbf{IS}^{\varphi}{}_{3.i} \subseteq \mathbf{IS}^{\varphi}{}_3$ $(i = \overline{1,q})$—component of the subtuple, which displays the i-th parameter identifier of the φ^{th} SRSA of the organization, and q is their number.

For example, according to [14], at $q = 11$ $(i = \overline{1,11})$ formula (3) can be represented as follows:

$$\mathbf{IS}^{\varphi}{}_3 = \left\langle \mathbf{IS}^{\varphi}{}_{3.1}, \mathbf{IS}^{\varphi}{}_{3.2}, \mathbf{IS}^{\varphi}{}_{3.3}, \mathbf{IS}^{\varphi}{}_{3.4}, \mathbf{IS}^{\varphi}{}_{3.5}, \mathbf{IS}^{\varphi}{}_{3.6}, \mathbf{IS}^{\varphi}{}_{3.7}, \mathbf{IS}^{\varphi}{}_{3.8}, \mathbf{IS}^{\varphi}{}_{3.9}, \mathbf{IS}^{\varphi}{}_{3.10}, \mathbf{IS}^{\varphi}{}_{3.11} \right\rangle =$$
$$\left\langle \mathbf{N}^{\varphi}, \mathbf{nE}^{\varphi}, \mathbf{nP}^{\varphi}, \mathbf{FA}^{\varphi}, \mathbf{nPN}^{\varphi}, \mathbf{nA}^{\varphi}, \mathbf{nSA}^{\varphi}, \mathbf{nRA}^{\varphi}, \mathbf{nWR}^{\varphi}, \mathbf{nGA}^{\varphi}, \mathbf{nWA}^{\varphi} \right\rangle.$$

where $\mathbf{IS}^{\varphi}{}_{3.1} = \mathbf{IS}^{\varphi}{}_{1.1} = \mathbf{N}^{\varphi}$ (*Name*) is the set "Actual and conditional (if available) name of the reporting entity"; $\mathbf{IS}^{\varphi}{}_{3.2} = \mathbf{nE}^{\varphi}$ (*number of Employees*) is the set "Total number of employees according to the staff list"; $\mathbf{IS}^{\varphi}{}_{3.3} = \mathbf{nP}^{\varphi}$ (*number of Positions*) is the set "Total number of positions included in the nomenclature of positions"; $\mathbf{IS}^{\varphi}{}_{3.4} = \mathbf{FA}^{\varphi}$ (*Forms of Access*) is the set "Forms of access"; $\mathbf{IS}^{\varphi}{}_{3.5} = \mathbf{nPN}^{\varphi}$ (*number of Positions included in the Nomenclature*) is the set "Number of positions included in the nomenclature of positions"; $\mathbf{IS}^{\varphi}{}_{3.6} = \mathbf{nA}^{\varphi}$ (*number of Employees with Access*) is the set "The number of employees who have access to SS"; $\mathbf{IS}^{\varphi}{}_{3.7} = \mathbf{nSA}^{\varphi}$ (*number of Employees with Suspended Access*) is the set "The number of employees whose access to SS has been terminated"; $\mathbf{IS}^{\varphi}{}_{3.8} = \mathbf{nRA}^{\varphi}$ (*number of employees with Revoked Access*)—the set "The number of employees whose access to SS has been cancelled"; $\mathbf{IS}^{\varphi}{}_{3.9} = \mathbf{nWR}^{\varphi}$ (*number of persons with Access Without Registration*)—the set "The number of persons who were granted access to the DT in the procedure defined by the law without obtaining admission to the DT"; $\mathbf{IS}^{\varphi}{}_{3.10} = \mathbf{nGA}^{\varphi}$ (*number of employees who Got Acquainted with classified information*)—the set "The number of employees who got acquainted with secret information in other enterprises, institutions, organizations"; $\mathbf{IS}^{\varphi}{}_{3.11} = \mathbf{nWA}^{\varphi}$ (*number of secret carriers who Went Abroad on private business*)—the set "The number of secret carriers who went abroad on private business".

For example, to assign specific values to the following eleven parameters of the third component $\mathbf{IS}^{\varphi}{}_3 \subseteq \mathbf{IS}^{\varphi}$ one will use SRSA $\mathbf{IS}^1 = \mathbf{IS}^{\text{NAU}}$ [14–19]:

$$\mathbf{IS}^{\varphi}{}_{3.1} = \mathbf{IS}^{\varphi}{}_{11} = \mathbf{N}^{\varphi} = \{\bigcup_{i=1}^{h_1} N^{\varphi}{}_i\} = \{N^{\varphi}{}_1, N^{\varphi}{}_2, ..., N^{\varphi}{}_{h_1}\}, \quad (4)$$

where, $N^{\varphi}{}_i \subseteq \mathbf{N}^{\varphi}$ $(i = \overline{1,h_1})$ is i^{th} valid full name and conventional name of the φ-th SRSA, and h_1 is the number of these names (for example, with, $\varphi = 1$, $q_1 = h_1$, $h_1 = 1$, (4) takes the form:

$\mathbf{N}^1 = \{\mathrm{U}_{\mathrm{i}=1}^1 \mathrm{N}^{\mathrm{NAU}}{}_{\mathrm{i}}\} = \{\mathrm{U}_{\mathrm{i}=1}^1 \mathrm{N}_1^{\mathrm{NAU}}\} =${"National Aviation University (NAU)"}) [18].

$$\mathbf{IS}^{\varphi}{}_{3.2} = \mathrm{nE}^{\varphi} = \{\bigcup_{i=1}^{q_2} nE^{\varphi}{}_i\} = \{nE^{\varphi}{}_1, nE^{\varphi}{}_2, ..., nE^{\varphi}{}_{q_2}\}, \quad (5)$$

where $nE^{\varphi}{}_i \subseteq \mathbf{nE}^{\varphi}$ $(i = \overline{1,q_2})$ is i^{th} identifier of the total number of employees according to the staff list, and q_2 is their number (for example, for $\mathbf{IS}^1 = \mathbf{IS}^{\text{NAU}}$, taking into account [20], with $\varphi = 1$, $q_2 = 1$ $(i = 1)$, then (5) is defined as:

$$\mathbf{nE}^1 = \left\{\bigcup_{\mathrm{i}-1}^{1} \mathrm{nE}^{\mathrm{NAU}}{}_{\mathrm{i}}\right\} = \left\{\bigcup_{\mathrm{i}-1}^{1} \mathrm{nE}^{\mathrm{NAU}}{}_{1}\right\} =$$
$$= \{\text{"4517,8"}\},$$

that is, the total number of NAU employees, according to the 2021 staff list, is 4517.8).

$$\mathbf{IS}^{\varphi}{}_{3.3} = \mathbf{nP}^{\varphi} = \{\bigcup_{i=1}^{q_3} nP^{\varphi}{}_i\} = \{nP^{\varphi}{}_1, nP^{\varphi}{}_2, ..., nP^{\varphi}{}_{q_3}\}, \quad (6)$$

where $nP^{\varphi}{}_i \subseteq \mathbf{nP}^{\varphi}$ $(i = \overline{1,q_3})$ is i^{th} identifier of the total number of positions included in the nomenclature of positions, and q_3 is their number (let the number of positions included in the nomenclature of cases be 10% of the total number of positions according to the staff list of NAU in 2021 [20], i.e. at $\varphi = 1$, $q_3 = 1$ $(i = 1)$, then (6) will be as:

$$\mathbf{nP}^1 = \left\{\bigcup_{\mathrm{i}=1}^{1} \mathrm{nP}^{\mathrm{NAU}}{}_{\mathrm{i}}\right\} = \left\{\bigcup_{\mathrm{i}=1}^{1} \mathrm{nP}^{\mathrm{NAU}}{}_{1}\right\} = \{\text{"452"}\}$$

that is, the total number of positions included in the nomenclature of positions is 452.

$$\mathbf{IS}^{\varphi}{}_{3.4} = FA^{\varphi} = \{\bigcup_{i=1}^{q_4} FA^{\varphi}{}_i\} = \{FA^{\varphi}{}_1, FA^{\varphi}{}_2, \ldots, FA^{\varphi}{}_{q_4}\}, \quad (7)$$

where $FA^{\varphi}{}_i \subseteq \mathbf{FA}^{\varphi}$ $(i = \overline{1, q_4})$ is i^{th} set of tolerance forms, and q_4 is their number (for example, respectively [1, 14] the tolerance forms are defined as first (or 1), second (or 2) and third (or 3), so when $q_4 = 3$ $(i = \overline{1,3})$, then (7) define as:

$$\mathbf{FA}^{\varphi} = \{\bigcup_{i=1}^{3} FA^{\varphi}{}_i\} = \{FA^{\varphi}{}_1, FA^{\varphi}{}_2, FA^{\varphi}{}_3\} = \{\text{“1”, “2”, “3”}\},$$

where $FA^{\varphi}{}_1$ = “1”, $FA^{\varphi}{}_2$ = “2”, $FA^{\varphi}{}_3$ = “3”. Assume that for $\varphi = 1$, $q_4 = 2$ $(i = \overline{1,2})$, then (7) takes the following form:

$$\mathrm{FA}^1 = \left\{\bigcup_{i=1}^{2} FA^{NAU}{}_i\right\} = \{FA^{NAU}{}_1, FA^{NAU}{}_2\} = \{\text{“1”, “2”}\},$$

i.e. in NAU there are forms of admission as the first (or 1) and the second (or 2).

$$\mathbf{IS}^{\varphi}{}_{3.5} = \mathbf{nPN}^{\varphi} = \{\bigcup_{i=1}^{q_4}\{\bigcup_{j=1}^{q_5} nPN^{\varphi}{}_{i.j}\}\} = \{\{nPN^{\varphi}{}_{1.1}, \ldots\}, \ldots, \{\ldots, nPN^{\varphi}{}_{i.j}, \ldots\}, \ldots, \{\ldots, nPN^{\varphi}{}_{q_4.q_5}\}\}, \quad (8)$$

where $nPN^{\varphi}{}_{i.j} \subseteq \mathbf{nPN}^{\varphi}$ $(i = \overline{1, q_4}, j = \overline{1, q_5})$ is i^{th} identifier of the number of positions included in the nomenclature of positions, and q_5 is their number for q_4, hat is, for a specific form of admission (for example, with $\varphi = 1$, for $q_4 = 2$ $(i = \overline{1,2})$, $q_5 = 1$ $(j = 1)$, then (8) will take the form:

$$\mathbf{nPN}^1 = \left\{\bigcup_{i=1}^{2}\bigcup_{j=1}^{1} nPN^{NAU}{}_{i.j}\right\} = \{\{nPN^{NAU}{}_{1.1}\}, \{nPN^{NAU}{}_{2.1}\}\} = \{\{\text{“300”}\}, \{\text{“150”}\}\},$$

that is, the number of positions in NAU included in the nomenclature of positions according to the first (or 1) form of admission is 300, and according to the second (or 2) form of admission—150).

$$\mathbf{IS}^{\varphi}{}_{3.6} = \mathbf{nA}^{\varphi} = \{\bigcup_{i=1}^{q_4}\{\bigcup_{j=1}^{q_6} nA^{\varphi}{}_{i.j}\}\} = \{\{nA^{\varphi}{}_{1.1}\}, \ldots, \{nA^{\varphi}{}_{i.j}\}, \ldots, \{nA^{\varphi}{}_{q_4.q_6}\}\}, \quad (9)$$

where $nA^{\varphi}{}_{i.j} \subseteq \mathbf{nA}^{\varphi}$ $(i = \overline{1, q_4}, j = \overline{1, q_6})$ is i^{th} identifier of the number of employees who have admission to SS, and q_6 is their number for q_4, that is, for a specific form of admission (for example, with $\varphi = 1$, for $q_4 = 2$ $(i = \overline{1,2})$, $q_6 = 1$ $(j = 1)$, then (9) will take the form of:

$$\mathbf{nA}^1 = \left\{\bigcup_{i=1}^{2}\bigcup_{j=1}^{1} nA^{NAU}{}_{i.j}\right\} = \{\{nA^{NAU}{}_{1.1}\}, \{nA^{NAU}{}_{2.1}\}\} = \{\{\text{“250”}\}, \{\text{“100”}\}\},$$

that is, the number of NAU employees who have admission to SS under the first (or 1) form of admission is 250, and 100 under the second (or 2) form of admission).

$$\mathbf{IS}^{\varphi}{}_{3.7} = \mathbf{nSA}^{\varphi} = \{\bigcup_{i=1}^{q_4}\{\bigcup_{j=1}^{q_7} nSA^{\varphi}{}_{i.j}\}\} = \{\{nSA^{\varphi}{}_{1.1}, \ldots\}, \ldots, \{\ldots, nSA^{\varphi}{}_{i.j}, \ldots\}, \ldots, \{\ldots, nSA^{\varphi}{}_{q_4.q_7}\}\}, \quad (10)$$

where $nSA^{\varphi}{}_{i.j} \subseteq \mathbf{nSA}^{\varphi}$ $(i = \overline{1, q_4}, j = \overline{1, q_7})$ is i^{th} identifier of the number of employees whose access to SS has been terminated, and q_7 is their number for q_4, hat is, for a specific form of admission (for example, $\varphi = 1$ for $q_4 = 2$ $(i = \overline{1,2})$, $q_7 = 1$ $(j = 1)$, then (10) will take the form of:

$$\mathbf{nSA}^1 = \left\{\bigcup_{i=1}^{2}\bigcup_{j=1}^{1} nSA^{NAU}{}_{i.j}\right\} = \{\{nSA^{NAU}{}_{1.1}\}, \{nSA^{NAU}{}_{2.1}\}\} = \{\{\text{“25”}\}, \{\text{“7”}\}\},$$

i.e. the number of NAU employees whose access to SS has been terminated for the first (or 1) form of admission is 25, and for the second (or 2) form of admission—7).

$$\mathbf{IS}^{\varphi}{}_{3.8} = \mathbf{nRA}^{\varphi} = \{\bigcup_{i=1}^{q_4}\{\bigcup_{j=1}^{q_8} nRA^{\varphi}{}_{i.j}\}\} = \{\{nRA^{\varphi}{}_{1.1}, \ldots\}, \ldots, \{\ldots, nRA^{\varphi}{}_{i.j}, \ldots\}, \ldots, \{\ldots, nRA^{\varphi}{}_{q_4.q_8}\}\}, \quad (11)$$

where $nRA^{\varphi}_{i.j} \subseteq \mathbf{nRA}^{\varphi}$ $(i=\overline{1,q_4}, j=\overline{1,q_8})$ is i^{th} identifier of the number of employees whose admission to SS has been canceled, and q_8 is their number according to q_4, that is, according to a specific form of admission (for example, if $\varphi=1$ for $q_4=2$ $(i=\overline{1,2})$, $q_8=1$ $(j=1)$, then (11) will be as:

$$\mathbf{nRA}^1 = \left\{\bigcup_{i=1}^{2}\bigcup_{j=1}^{1} nRA^{NAU}{}_{i.j}\right\} = \left\{\{nRA^{NAU}{}_{1.1}\},\{nRA^{NAU}{}_{2.1}\}\right\} = \{\{\text{“25”}\},\{\text{“7”}\}\},$$

i.e. the number of NAU employees whose access to SS has been canceled for the first (or 1) form of admission is 25, and for the second (or 2) form of admission—7, or in this case $\mathbf{IS}^{\varphi}{}_{3.8} = \mathbf{IS}^{\varphi}{}_{3.7}$).

$$\mathbf{IS}^{\varphi}{}_{3.9} = \mathbf{nWR}^{\varphi} = \{\bigcup_{i=1}^{q_4}\{\bigcup_{j=1}^{q_9} nWR^{\varphi}{}_{i.j}\}\} = \{\{nWR^{\varphi}{}_{1.1},\ldots\},\ldots,\{\ldots,nWR^{\varphi}{}_{i.j},\ldots\},\ldots,\{\ldots,nWR^{\varphi}{}_{q_4.q_9}\}\}, \quad (12)$$

where $nWR^{\varphi}{}_{i.j} \subseteq \mathbf{nWR}^{\varphi}$ $(i=\overline{1,q_4}, j=\overline{1,q_9})$ is i^{th} identifier of the number of persons who were granted access to the SS in the manner specified by the legislation without obtaining admission to the SS, and q_9 is their number according to q_4, that is, according to a specific form of admission (for example, with $\varphi=1$, for $q_4=2$ $(i=\overline{1,2})$, $q_9=1$ $(j=1)$, then (12) will be as:

$$\mathbf{nWR}^1 = \left\{\bigcup_{i=1}^{2}\bigcup_{j=1}^{1} nWR^{NAU}{}_{i.j}\right\} = \left\{\{nWR^{NAU}{}_{1.1}\},\{nWR^{NAU}{}_{2.1}\}\right\} = \{\{\text{“4”}\},\{\text{“2”}\}\},$$

i.e. the number of persons who were granted access to SS at NAU following the procedure specified by law without registration of admission to SS according to the first (or 1) form of admission is 4, and according to the second (or 2) form of admission—2).

$$\mathbf{IS}^{\varphi}{}_{3.10} = \mathbf{nGA}^{\varphi} = \{\bigcup_{i=1}^{q_4}\{\bigcup_{j=1}^{q_{10}} nGA^{\varphi}{}_{i.j}\}\} = \{\{nGA^{\varphi}{}_{1.1},\ldots\},\ldots,\{\ldots,nGA^{\varphi}{}_{i.j},\ldots\},\ldots,\{\ldots,nGA^{\varphi}{}_{q_4.q_{10}}\}\}, \quad (13)$$

where $nGA^{\varphi}{}_{i.j} \subseteq \mathbf{nGA}^{\varphi}$ $(i=\overline{1,q_4}, j=\overline{1,q_{10}})$ is i^{th} identifier of the number of employees who got acquainted with secret information in other enterprises, institutions, organizations, and q_{10} is their number for q_4, that is, for a specific form of admission (for example, with $\varphi=1$, for $q_4=2$ $(i=\overline{1,2})$, $q_{10}=1$ $(j=1)$, then (13) will take the form of:

$$\mathbf{nGA}^1 = \left\{\bigcup_{i=1}^{2}\bigcup_{j=1}^{1} nGA^{NAU}{}_{i.j}\right\} = \left\{\{nGA^{NAU}{}_{1.1}\},\{nGA^{NAU}{}_{2.1}\}\right\} = \{\{\text{“5”}\},\{\text{“3”}\}\},$$

that is, the number of NAU employees who got acquainted with classified information in other enterprises, institutions, and organizations according to the first (or 1) form of admission is 5, and according to the second (or 2) form of admission—3).

$$\mathbf{IS}^{\varphi}{}_{3.11} = \mathbf{nWA}^{\varphi} = \{\bigcup_{i=1}^{q_4}\{\bigcup_{j=1}^{q_{11}} nWA^{\varphi}{}_{i.j}\}\} = \{\{nWA^{\varphi}{}_{1.1},\ldots\},\ldots,\{\ldots,nWA^{\varphi}{}_{i.j},\ldots\},\ldots,\{\ldots,nWA^{\varphi}{}_{q_4.q_{11}}\}\} \quad (14)$$

where $nWA^{\varphi}{}_{i.j} \subseteq \mathbf{nWA}^{\varphi}$ $(i=\overline{1,q_4}, j=\overline{1,q_{11}})$ is j^{th} identifier of the number of secret carriers who went abroad on private business, and q_9 is their number for q_4, that is, for a specific i^{th} form of admission (for example, with $\varphi=1$, for $q_4=2$ $(i=\overline{1,2})$, $q_{11}=1$ $(j=1)$, then (14) will be as:

$$\mathbf{nWR}^1 = \left\{\bigcup_{i=1}^{2}\bigcup_{j=1}^{1} nWR^{NAU}{}_{i.j}\right\} = \left\{\{nWR^{NAU}{}_{1.1}\},\{nWR^{NAU}{}_{2.1}\}\right\} = \{\{\text{“4”}\},\{\text{“2”}\}\},$$

that is, the number of secret carriers in NAU who went abroad on private business under the first (or 1) form of admission is 4, and under the second (or 2) form of admission—2).

The fourth component of the subtuple $\mathbf{IS}^{\varphi}{}_4$ **= Section 4 (“Information on the number of material carriers of secret information”)** is formed by filling in the SRSA of the graphs (parameters) of the corresponding section of the Report [14], which is displayed as:

$$\mathbf{IS}^{\varphi}{}_4 = \left\langle \mathbf{IS}^{\varphi}{}_{4.1}, \mathbf{IS}^{\varphi}{}_{4.2}, \ldots, \mathbf{IS}^{\varphi}{}_{4.i}, \ldots, \mathbf{IS}^{\varphi}{}_{4.k} \right\rangle, \quad (15)$$

where $\mathbf{IS}^{\varphi}_{4.i} \subseteq \mathbf{IS}^{\varphi}_{4}$ $(i = \overline{1,k})$ is component of the subtuple displaying the ith identifier of the RSO parameters of the φ-th SRSA, and k is their number.

For example, according to the requirements of [14], when $k = 10$ $(i = \overline{1,10})$ formula (15) can be represented as follows:

$$\mathbf{IS}^{\varphi}_{4} = \left\langle \mathbf{IS}^{\varphi}_{4.1}, \mathbf{IS}^{\varphi}_{4.2}, \mathbf{IS}^{\varphi}_{4.3}, \mathbf{IS}^{\varphi}_{4.4}, \mathbf{IS}^{\varphi}_{4.5}, \mathbf{IS}^{\varphi}_{4.6}, \mathbf{IS}^{\varphi}_{4.7}, \mathbf{IS}^{\varphi}_{4.8}, \mathbf{IS}^{\varphi}_{4.9}, \mathbf{IS}^{\varphi}_{4.10} \right\rangle =$$
$$\left\langle \mathbf{N}^{\varphi}, \mathbf{SS}^{\varphi}, \mathbf{aM}^{\varphi}, \mathbf{nsM}^{\varphi}, \mathbf{nrM}^{\varphi}, \mathbf{nMr}^{\varphi}, \mathbf{nMt}^{\varphi}, \mathbf{nMf}^{\varphi}, \mathbf{sU}^{\varphi}, \mathbf{nMu}^{\varphi} \right\rangle,$$

where: $\mathbf{IS}^{\varphi}_{4.1} = \mathbf{IS}^{\varphi}_{1.1} = \mathbf{N}^{\varphi}$ (*Name*)—set "Actual and conditional (if available) name of the reporting entity (SRSA)"; $\mathbf{IS}^{\varphi}_{4.2} = \mathbf{SS}^{\varphi}$ (*Stamp of Secrecy*)—set "Stamp of Secrecy"; $\mathbf{IS}^{\varphi}_{4.3} = \mathbf{aM}^{\varphi}$ (*all Material Carriers of Classified Information*)—set "Total MCCI (sum of columns 5-13)"; $\mathbf{IS}^{\varphi}_{4.4} = \mathbf{nsM}^{\varphi}$ (*Number of registered and Stored MCCI at the end of the reporting period*)—set "The number of MCCIs that are registered and maintained as of the end of the reporting period"; $\mathbf{IS}^{\varphi}_{4.5} = \mathbf{nrM}^{\varphi}$ (*Number of Registered MCCI in the reporting period*)—set "Number of registered MCCI in the reporting period"; $\mathbf{IS}^{\varphi}_{4.6} = \mathbf{nMr}^{\varphi}$ (*number of MCCI, the secrecy stamps of which have been revised*)—set "The number of MCCI, the secrecy vultures of which have been revised"; $\mathbf{IS}^{\varphi}_{4.7} = \mathbf{nMt}^{\varphi}$ (*number of MCCI transferred to foreign states and international organizations in the reporting period*)—set "The number of MCCI that were transferred to foreign states and international organizations in the reporting period"; $\mathbf{IS}^{\varphi}_{4.8} = \mathbf{nMf}^{\varphi}$ (*number of MCCI with stamps restricting access of foreign states and international organizations)*—set "The number of MCCI with the access restriction vultures of foreign states and international organizations (provided in columns taking into account the comparison with the vultures of secrecy of Ukraine following international treaties)"; $\mathbf{IS}^{\varphi}_{4.9} = \mathbf{sU}^{\varphi}$ (*stamps restricting access of USSR*)—set "Access restriction vultures of the former USSR"; $\mathbf{IS}^{\varphi}_{4.10} = \mathbf{nMu}^{\varphi}$ (*number of MCCI with stamps restricting access of USSR*)—set "Number of MCCI with access restriction vultures of the former USSR".

For example, to assign specific values to the specified seven parameters of the fourth component $\mathbf{IS}^{\varphi}_{4} \subseteq \mathbf{IS}^{\varphi}$ one will use SRSA $\mathbf{IS}^{1} = \mathbf{IS}^{NAU}$ [14–18, 20]:

$\mathbf{IS}^{\varphi}_{4.1} = \mathbf{IS}^{\varphi}_{1.1} = \mathbf{N}^{\varphi}$, $k_1 = h_1$ (see (4) [18]).

$$\mathbf{IS}^{\varphi}_{4.2} = \mathbf{SS}^{\varphi} = \{\bigcup_{i=1}^{k_2} SS^{\varphi}_{i}\} = \{SS^{\varphi}_{1}, SS^{\varphi}_{2}, ..., SS^{\varphi}_{k_2}\}, \quad (16)$$

where $SS^{\varphi}_{i} \subseteq \mathbf{SS}^{\varphi}$ $(i = \overline{1,k_2})$ is ith is the identifier of the number of secrecy vultures of the Ministry of Internal Affairs and Communications, and a is their number. According to the Law of Ukraine "On State Secrets" [1] and taking into account [14] the Ministry of Internal Affairs and Communications is classified according to the classification of secrecy into: "secret" (or S), "top secret" (or TS) and "of special importance" (or SI), therefore k_2 = 3 formula (16) looks like:

$$\mathbf{SS}^{\varphi} = \{\bigcup_{i=1}^{3} SS^{\varphi}_{i}\} = \{SS^{\varphi}_{1}, SS^{\varphi}_{2}, SS^{\varphi}_{3}\} =$$
{"S", "TS", "SI"}.

$$\mathbf{IS}^{\varphi}_{4.3} = \mathbf{aM}^{\varphi} = \{\bigcup_{i=1}^{k_2}\{\bigcup_{j=1}^{k_3} aM^{\varphi}_{i.j}\}\} = \{\{aM^{\varphi}_{1.1}, ...\}, ..., \{..., aM^{\varphi}_{i.j}, ...\}, ..., \{..., aM^{\varphi}_{k_2.k_3}\}\}, \quad (17)$$

where $aM^{\varphi}_{i.j} \subseteq \mathbf{aM}^{\varphi}$ $(i = \overline{1,k_2}, j = \overline{1,k_3})$ is jth identifier of all MCCI (as the number of the sum of graphs 5–13), and k_3 is their number for each k_2, i.e. according to the specific ith secret code (let's imagine that $\varphi = 1$ for $k_2 = 2$ $(i = \overline{1,2})$, $k_3 = 1$ $(j = 1)$, then (17) will be as:

$$\mathbf{aM}^{1} = \left\{\bigcup_{i=1}^{2}\bigcup_{j=1}^{1} aM^{NAU}_{i.j}\right\} =$$
$$= \left\{\{aM^{NAU}_{1.1}\}, \{aM^{NAU}_{2.1}\}\right\} = \{\{\text{"215"}\}, \{\text{"75"}\}\},$$

that is, in the NAU of all MCCIs, according to the secrecy vultures "secret" (or S)—215, and "top secret" (or TS)—75.

$$\mathbf{IS}^{\varphi}{}_{4.4} = \boldsymbol{nsM}^{\varphi} = \{\bigcup_{i=1}^{k_2}\{\bigcup_{j=1}^{k_{4.i}} nsM^{\varphi}{}_{i.j}\}\} = \{\{nsM^{\varphi}{}_{1.1},...\},...,\{...,nsM^{\varphi}{}_{i.j},...\},...,\{...,nsM^{\varphi}{}_{k_2.k_{4.i}}\}\}, \quad (18)$$

where $nsM^{\varphi}{}_{i.j} \subseteq \boldsymbol{nsM}^{\varphi}$ $(i=\overline{1,k_2}, j=\overline{1,k_{4.i}})$ is j^{th} identifier of the number of MCCIs, which are registered and stored as of the end of the reporting period, and $k_{4.i}$ is their number for each k_2, that is, according to a specific i^{th} security seal (for example, taking into account [14], with $k_4 = 7$ $(j=\overline{1,7})$, $k_{4.1} = 4$, $k_{4.2} \div k_{4.7} = 1$ 18) we represent as:

$$\boldsymbol{nsM}^{\varphi} = \{\bigcup_{i=1}^{7}\{\bigcup_{j=1}^{k_{4.i}} nsM^{\varphi}_{i.j}\}\} =$$

$$\{\{nsM^{\varphi}_{1.1}, nsM^{\varphi}_{1.2}, nsM^{\varphi}_{1.3}, nsM^{\varphi}_{1.4}\}, \{nsM^{\varphi}_{2.1}\}, \{nsM^{\varphi}_{3.1}\}, \{nsM^{\varphi}_{4.1}\},... \{nsM^{\varphi}_{7.1}\}\},$$

where $nsM^{\varphi}_{i.j}$ is the set number of MCCIs that are registered and kept as of the end of the reporting period [14]: $nsM^{\varphi}_{i.1}$ is the set "number of MCCIs relating to cryptographic protection of information": ($nsM^{\varphi}_{i.1.1}$ is subset "number of means of cryptographic protection of information"; $nsM^{\varphi}_{i.1.2}$ is subset "number of books of technical (operational) and regulatory documentation"; $nsM^{\varphi}_{i.1.3}$ is subset "number of key documents"; $nsM^{\varphi}_{i.1.4}$ is subset "number of MCCI of the state recognition system"); $nsM^{\varphi}_{i.2}$—set of "normative and administrative acts"; $nsM^{\varphi}_{i.3}$ is set "technical and operational documentation"; $nsM^{\varphi}_{i.4}$ is set of "secret products"; $nsM^{\varphi}_{i.5}$—the set "other MCCI (volumes of cases, copies of publications, photo documents, notebooks, etc.)"; $nsM^{\varphi}_{i.6}$—set "a number of machine media (FMD, HMDD, CDs, flash drives, microfilms)"; $nsM^{\varphi}_{i.7}$ is set "including with the mark "Letter "M".

For example, if $\varphi = 1$ for $k_2 = 2$ $(i=\overline{1,2})$, $k_4 = 7$ $(j=\overline{1,7})$, $k_{4.1} = 4$, $k_{4.2} \div k_{4.7} = 1$ then (18), taking into account the composition of the set $nsM^{\varphi}_{i.1}$, will be as [14]:

$$\boldsymbol{nsM}^{\varphi} = \{\bigcup_{i=1}^{2}\{\bigcup_{j=1}^{7}\{\bigcup_{e=1}^{k_{4.i}} nsM^{\varphi}_{i.j.e}\}\} =$$

$$= \{\{nsM^{\varphi}_{1.1.1}, nsM^{\varphi}_{1.1.2}, nsM^{\varphi}_{1.1.3}, nsM^{\varphi}_{1.1.4}\}, \{nsM^{\varphi}_{1.2.1}\}, \{nsM^{\varphi}_{1.3.1}\}, \{nsM^{\varphi}_{1.4.1}\},... \{nsM^{\varphi}_{1.7.1}\},$$

$$\{nsM^{\varphi}_{2.1.1}, nsM^{\varphi}_{2.1.2}, nsM^{\varphi}_{2.1.3}, nsM^{\varphi}_{2.1.4}\}, \{nsM^{\varphi}_{2.2.1}\}, \{nsM^{\varphi}_{2.3.1}\}, \{nsM^{\varphi}_{2.4.1}\},... \{nsM^{\varphi}_{2.7.1}\}\} =$$

$$= \{\{nsM^{\varphi}_{1.1.1}, nsM^{\varphi}_{1.1.2}, nsM^{\varphi}_{1.1.3}, nsM^{\varphi}_{1.1.4}\}, \{nsM^{\varphi}_{1.2.1}\}, \{nsM^{\varphi}_{1.3.1}\}, \{nsM^{\varphi}_{1.4.1}\}, \{nsM^{\varphi}_{1.5.1}\}, \{nsM^{\varphi}_{1.6.1}\}, \{nsM^{\varphi}_{1.7.1}\}\},$$

$$\{\{nsM^{\varphi}_{2.1.1}, nsM^{\varphi}_{2.1.2}, nsM^{\varphi}_{2.1.3}, nsM^{\varphi}_{2.1.4}\}, \{nsM^{\varphi}_{2.2.1}\}, \{nsM^{\varphi}_{2.3.1}\}, \{nsM^{\varphi}_{2.4.1}\}, \{nsM^{\varphi}_{2.5.1}\}, \{nsM^{\varphi}_{2.6.1}\}, \{nsM^{\varphi}_{2.7.1}\}\} =$$

= {{"20", "15", "15", "5"}, {"30"}, {"25"}, {"40"}, {"50"}, {"10"}, {"5"}},
{{"10", "5", "5", "5"}, {"5"}, {"10"}, {"10"}, "10"}, {"10"}, {"5"}},

i.e., in NAU, the number of MCCI, which are registered and stored as of the end of the reporting period, with secrecy vultures: 1) "secret" (or S): the number of MCCI related to cryptographic protection of information: the number of means of cryptographic protection of information—20; the number of books of technical (operational) and regulatory documentation—15; number of key documents—15; number of MCCI of the state recognition system—5; regulatory and administrative acts—30; technical and operational documentation—25; secret products—40; other MCCI (volumes of cases, copies of publications, photo documents, notebooks, etc.)—50; the number of computer media (FMD, HMDD, CDs, flash drives, microfilms)—10; including with the mark "Letter "M"—5; 2) "top secret" (or TS): number of MCCI related to cryptographic protection of information: number of means of cryptographic protection of information—10; the number of books of technical (operational) and regulatory documentation—5; number of

key documents—5; number of MCCI of the state recognition system—5; regulatory and administrative acts—5; technical and operational documentation—10; secret products—10; other MCCI (case volumes, copies of publications, photo documents, notebooks, etc.)—10; the number of computer media (FMD, HMDD, CDs, flash drives, microfilms)—10; including with the mark "Letter "M"—5.

$$\mathbf{IS}^{\varphi}{}_{4.5} = \mathbf{nrM}^{\varphi} = \{\bigcup_{i=1}^{k_2}\{\bigcup_{j=1}^{k_5} nrM^{\varphi}{}_{i.j}\}\} = \{\{nrM^{\varphi}{}_{1.1},...\},...,\{...,nrM^{\varphi}{}_{i.j},...\},...,\{...,nrM^{\varphi}{}_{k_2.k_5}\}\}, \quad (19)$$

where $nrM^{\varphi}{}_{i.j} \subseteq \mathbf{nrM}^{\varphi}$ $(i=\overline{1,k_2}, j=\overline{1,k_5})$ is j^{th} identifier of other MNSI (volumes of cases, copies of publications, photo documents, notebooks, etc.), and k_5 is their number for each k_2, that is, according to a specific i^{th} classification of secrecy (for example, taking [14] into account, when $\varphi=1$ for $k_2=2$ $(i=\overline{1,2})$, $k_5=4$ $(j=\overline{1,4})$, then (19) will be:

$$\mathbf{nrM}^1 = \left\{\bigcup_{i=1}^{2}\bigcup_{j=1}^{4} nrM^{NAU}{}_{i.j}\right\} =$$
$$\left\{\{nrM^{NAU}{}_{1.1}, nrM^{NAU}{}_{1.2}, nrM^{NAU}{}_{1.3}, nrM^{NAU}{}_{1.4}\}, \{nrM^{NAU}{}_{2.1}, nrM^{NAU}{}_{2.2}, nrM^{NAU}{}_{2.3}, nrM^{NAU}{}_{2.4}\}\right\} =$$
$$= \{\{\text{"14"}, \text{"7"}, \text{"2"}, \text{"5"}\}, \{\text{"5"}, \text{"3"}, \text{"2"}, \text{"1"}\}\},$$

i.e., in NAU, the number of registered MCCI in the reporting period with the seal of secrecy: 1) "secret" (or S): received (incoming)—14, prepared (outgoing)—7, sent—2, destroyed—5; 2) "completely secret" (or CS): received (incoming)—5, prepared (outgoing)—3; sent—2; destroyed—1).

$$\mathbf{IS}^{\varphi}{}_{4.6} = \mathbf{nMr}^{\varphi} = \{\bigcup_{i=1}^{k_2}\{\bigcup_{j=1}^{k_6} nMr^{\varphi}{}_{i.j}\}\} = \{\{nMr^{\varphi}{}_{1.1},...\},...,\{...,nMr^{\varphi}{}_{i.j},...\},...,\{...,nMr^{\varphi}{}_{k_2.k_6}\}\}, \quad (20)$$

where $nMr^{\varphi}{}_{i.j} \subseteq \mathbf{nMr}^{\varphi}$ $(i=\overline{1,k_2}, j=\overline{1,k_6})$ is j^{th} identifier of the number of MCCI, the security vultures of which have been reviewed, and k_6 is their number for each k_2, that is, according to the specific i^{th} security vulture (for example, taking into account [14], when $\varphi=1$ for $k_2=2$ $(i=\overline{1,2})$, $k_6=3$ $(j=\overline{1,3})$, then (20) will be as:

$$\mathbf{nMr}^1 = \left\{\bigcup_{i=1}^{2}\bigcup_{j=1}^{3} nMr^{NAU}{}_{i.j}\right\} =$$
$$\left\{\{nMr^{NAU}{}_{1.1}, nMr^{NAU}{}_{1.2}, nMr^{NAU}{}_{1.3}\}, \{nMr^{NAU}{}_{2.1}, nMr^{NAU}{}_{2.2}, nMr^{NAU}{}_{2.3}\}\right\} =$$
$$= \{\{\text{"4"}, \text{"7"}, \text{"2"}\}, \{\text{"3"}, \text{"2"}, \text{"0"}\}\},$$

i.e., in NAU, the number of MCCI whose secrecy vultures were revised, namely: 1) "secret" (or S): brought into line with the current CISS (secrecy vulture changed)—4, transferred to the category with the access restriction vulture "For official use"—7, declassified (removed access restriction stamp)—2; 2) "top secret" (or TS): brought into line with the current CISS (secrecy seal changed)—3, transferred to the category with the access restriction seal "For official use"—2, declassified (access restriction seal removed)—0).

$$\mathbf{IS}^{\varphi}{}_{4.7} = \mathbf{nMt}^{\varphi} = \{\bigcup_{i=1}^{k_2}\{\bigcup_{j=1}^{k_7} nMt^{\varphi}{}_{i.j}\}\} = \{\{nMt^{\varphi}{}_{1.1}\}, ..., \{nMt^{\varphi}{}_{i.j}\},..., \{nMt^{\varphi}{}_{k_2.k_7}\}\}, \quad (21)$$

where $nMt^{\varphi}{}_{i.j} \subseteq \mathbf{nMt}^{\varphi}$ $(i=\overline{1,k_2}, j=\overline{1,k_7})$ is j^{th} identifier of the number of MNSI, which was transferred to foreign states and international organizations in the reporting period, and k_7 is their number for each k_2, i.e. according to the specific i^{th} secrecy vulture (let's imagine that if $\varphi=1$, for $k_2=2$ $(i=\overline{1,2})$, $k_7=1$ $(j=1)$, then (21) will be as:

$$\mathbf{nMt}^1 = \left\{\bigcup_{i=1}^{2}\bigcup_{j=1}^{1} nMt^{NAU}{}_{i.j}\right\} =$$
$$= \left\{\{nMt^{NAU}{}_{1.1}\}, \{nMt^{NAU}{}_{2.1}\}\right\} =$$
$$= \{\{\text{"6"}\}, \{\text{"1"}\}\},$$

i.e., in the NAU, the number of MCCI, which were transferred to foreign states and international organizations in the reporting period with the vultures of secrecy "secret" (or S)—6, and "top secret" (or TS)—1.

$$\mathbf{IS}^{\varphi}{}_{4.8} = \mathbf{nMf}^{\varphi} = \{\bigcup_{i=1}^{k_2}\{\bigcup_{j=1}^{k_{8.i}} nMf^{\varphi}{}_{i.j}\}\} = \{\{nMf^{\varphi}{}_{1.1},...\},,...,\{...,nMf^{\varphi}{}_{i.j},...\},...,\{...,nMf^{\varphi}{}_{k_2.k_{8.k_2}}\}\}, \quad (22)$$

where $nMf^{\varphi}{}_{i.j} \subseteq \mathbf{nMf}^{\varphi}$ $(i=\overline{1,k_2}, j=\overline{1,k_{8.i}})$ is j^{th} identifier of the number of MNI with restrictions on the access of foreign states and international organizations (placed in columns taking into account the comparison with the secrecy of Ukraine following international treaties), and $k_{8.i}$ is their number for each k_2, hat is, according to the specific i^{th} security of secrecy (for example, taking into account [14], when $k_8 = 2$ $(j=\overline{1,2})$, $k_{8.1}=2$, $k_{8.2}=1$, then we present (22) as:

$$\mathbf{nMf}^{\varphi} = \{\bigcup_{i=1}^{2}\{\bigcup_{j=1}^{k_{8.i}} nMf^{\varphi}_{i.j}\}\} =$$

$$= \{\{nMf^{\varphi}_{i.1.1}, nMf^{\varphi}_{i.1.2}\}, nMf^{\varphi}_{i.2}\},$$

where $nMf^{\varphi}_{i.j}$ is set "The number of MCCI with restrictions on the access of foreign states and international organizations (put in columns taking into account the comparison with the secrecy of Ukraine following international treaties)" includes [14]: $nMf^{\varphi}_{i.1}$ is set "Total number of MCCI as of the end of the reporting period" ($nMf^{\varphi}_{i.1.1}$ is subset of "Total"; $nMf^{\varphi}_{i.1.2}$ is subset "including which arrived in the reporting period"); $nMf^{\varphi}_{i.2}$ is set "The number of MCCI, which were produced in the reporting period on the order of foreign states or international organizations."

For example, if $\varphi = 1$ for $k_2 = 2$ $(i=\overline{1,2})$, $k_8 = 2$ $(j=\overline{1,2})$, $k_{8.1}=2$, $k_{8.2}=1$ then (22), taking into account the composition of the set $nMf^{\varphi}_{i.1}$, will be as [14]:

$$\mathbf{nMf}^{\varphi} = \{\bigcup_{i=1}^{2}\{\bigcup_{j=1}^{2}\{\bigcup_{u=1}^{k_{8.i}} nMf^{\varphi}_{i.j.u}\}\} = \{\{nMf^{\varphi}_{i.1.1}, nMf^{\varphi}_{i.1.2}\}, nMf^{\varphi}_{i.2}\} =$$

$$= \{\{nMf^{\varphi}_{1.1.1}, nMf^{\varphi}_{1.1.2},\}, \{nMf^{\varphi}_{1.2}\}\}, \{\{nMf^{\varphi}_{2.1.1}, nMf^{\varphi}_{2.1.2}\}, \{nsM^{\varphi}_{2.2}\}\} =$$

= {{"20", "15"}, {"30"}}, {{"10", "5"}, {"5"}},

i.e., in NAU, the number of MCCIs with restrictions on the access of foreign states and international organizations (put in columns taking into account the comparison with Ukrainian secrecy vultures following international treaties) is as follows: 1) "secret" (or S): the total number of MCCIs as of the end of the reporting period: total—20, incl. which arrived in the reporting period—15; the number of MCCI, which were produced in the reporting period on the order of foreign states or international organizations—30; 2) "completely secret" (or CS): the total number of MCCI as of the end of the reporting period: a total of 10, including which arrived in the reporting period—5; the number of MCCI, which were produced in the reporting period on the order of foreign states or international organizations—5.

$$\mathbf{IS}^{\varphi}{}_{4.9} = \mathbf{sU}^{\varphi} = \{\bigcup_{i=1}^{k_9} sU^{\varphi}{}_i\} = \{sU^{\varphi}{}_1, sU^{\varphi}{}_2, ..., sU^{\varphi}{}_{k_9}\}, \quad (23)$$

where $sU^{\varphi}{}_i \subseteq \mathbf{sU}^{\varphi}$ $(i=\overline{1,k_9})$ is i^{th} identifier of the access restriction vultures of the former USSR, and k_9 is their number. According to [14], they are as follows: "secret" (or S), "top secret" (or TS), and "of special importance" (or SI), so at k_9 = 3 $(i=\overline{1,3})$ formula (23) looks like:

$$\mathbf{sU}^{\varphi} = \{\bigcup_{i=1}^{3} sU^{\varphi}{}_i\} = \{sU^{\varphi}{}_1, sU^{\varphi}{}_2, sU^{\varphi}{}_3\} =$$

= {"C", "CC", "OB"}.

$$\mathbf{IS}^{\varphi}{}_{4.10} = \mathbf{nMu}^{\varphi} = \{\bigcup_{i=1}^{k_9}\{\bigcup_{j=1}^{k_{10}} nMu^{\varphi}{}_{i.j}\}\} = \{\{nMu^{\varphi}{}_{1.1}\},...,\{nMu^{\varphi}{}_{i.j}\},...,\{nMu^{\varphi}{}_{k_9.k_{10}}\}\}, \quad (24)$$

where $nMu^{\varphi}{}_{i.j} \subseteq \mathbf{nM}^{\varphi}$ $(i=\overline{1,k_9}, j=\overline{1,k_{10}})$ is j^{th} identifier of the number of MCCI with access restriction vultures of the former USSR, and k_{10} is their number for each k_9, i.e. for a specific i^{th} vulture of access restriction of the former USSR (for example, taking into account [14], $\varphi=1$ for $k_9=2$ $(i=\overline{1,2})$, $k_{10}=2$ $(j=\overline{1,2})$, then (24) will be as:

$$\mathbf{nMu}^1 = \left\{ \bigcup_{i=1}^{2} \bigcup_{j=1}^{2} nMu^{NAU}{}_{i.j} \right\} =$$

$$= \left\{ \{nMu^{NAU}{}_{1.1}, nMu^{NAU}{}_{1.2}\}, \{nMu^{NAU}{}_{2.1}, nMu^{NAU}{}_{2.2}\} \right\} =$$

$$= \{\{\text{“14”}, \text{“17”}\}, \{\text{“8”}, \text{“3”}\}\},$$

i.e., in NAU, the number of MCCI with access restriction stamps of the former USSR is as follows: 1) “secret” (or S): the total number of MCCI as of the end of the reporting period (without taking into account interstate standards of limited distribution of the former USSR) is 14, the total number of copies of interstate standards of restricted distribution of the former USSR—17; 2) “top secret” (or TS): the total number of MCCI as of the end of the reporting period (not including interstate standards of limited distribution of the former USSR) is 8, the total number of copies of interstate standards of limited distribution of the former USSR is 3.

The developed model's general hierarchical structure (considering the given examples) is presented in Fig. 1

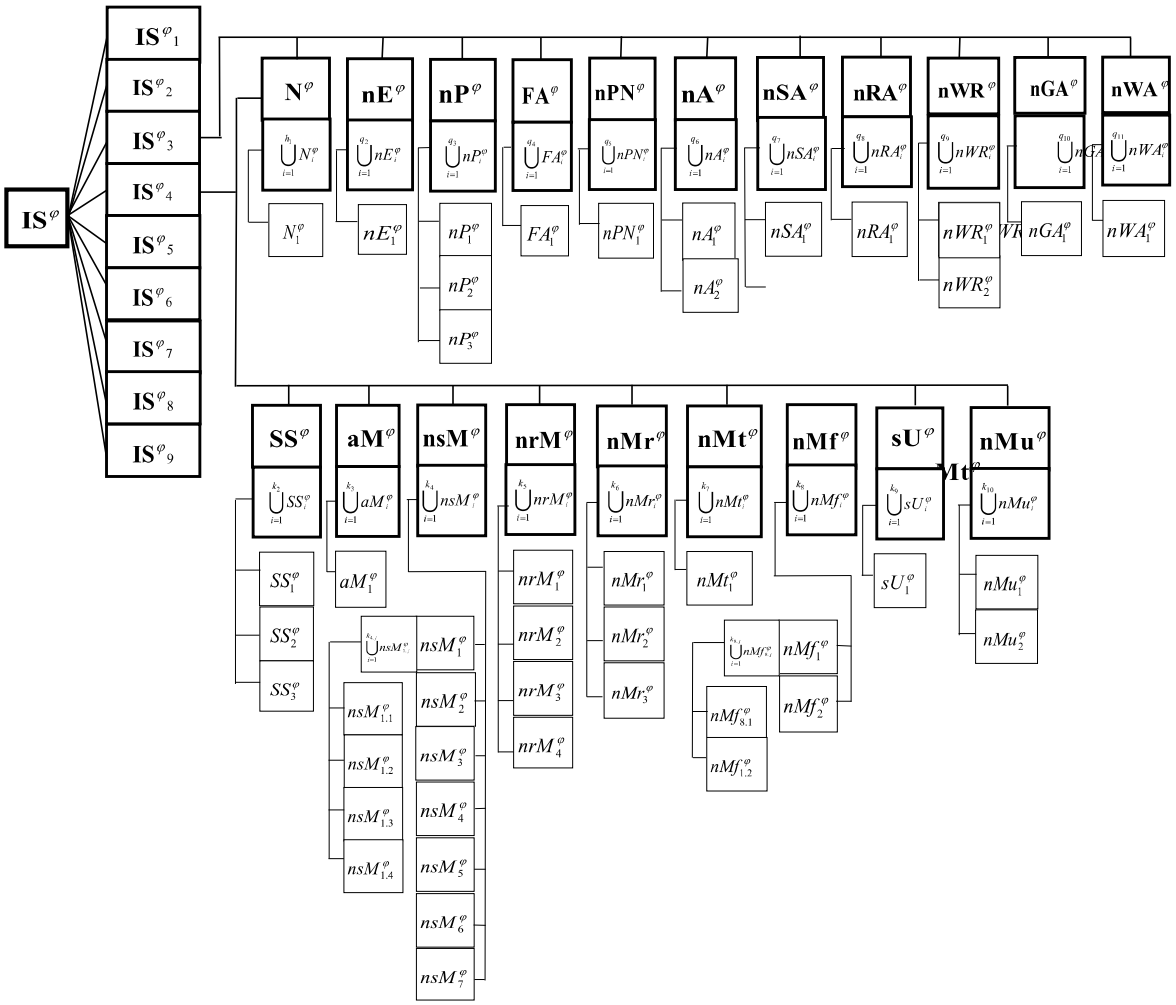

Figure 1: Hierarchical structure of the tuple model of internal parameter database formation

4. Conclusions

A tuple model was developed, which, due to the set-theoretic representation of sets of tuple models of the integrated representation of the internal parameters of the state of provision of PSS, which reflect the values of the reporting period as a set characterizing the MCCI and the number of employees with access and admission to the PSS, etc., allows determining the required number of initial values to form a database, keep statistics and improve the formalization of the

process of assessing damage (damages) from the loss of SS to the national security of Ukraine, both at the level of the state and the level of its regions, territorial communities following the legislation of Ukraine.

In the future, to implement the evaluation process, it is necessary to continue the development of a tuple model for the formation of a database of secondary parameters to improve the Method following domestic regulatory requirements, and in the future, taking into account the legislation of NATO member countries and the European Union.

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