

Saimaa University of Applied Sciences
Faculty of Technology, Lappeenranta
Double Degree program in Civil and Construction Engineering

Bakhtina Natalia

**DESIGN ASSIGNMENT DEVELOPMENT AND
STATE EXPERT REVIEW OF DESIGN
DOCUMENTATION IN RUSSIA**

Bachelor's Thesis 2011

ABSTRACT

Bakhtina Natalia

Design Assignment Development and State Expert Review of Design

Documentation in Russia, 57 pages, 4 appendices

Saimaa University of Applied Sciences, Lappeenranta

Double Degree Programme in Civil and Construction Engineering

Bachelor's Thesis 2011

Tutors: Laakso Sami, Kirsi Taivalantti, Olli Saruaho

The client of this thesis is an engineering company specializing in planning and managing water, wastewater and environmental technology solutions. The main sphere of operations includes supplies of various treatment equipment and machinery, supervision of its installation, commissioning and training. The point is that every kind of delivered equipment has its own features, which should be taken into account during designing of foundations, supporting and envelope structures, ventilation and different supply systems.

So the goal of this thesis work is to investigate what kind of initial data and initial requirements should be provided by this company to related design departments during project implementation. As far as this process is tied with development of several individual design assignments, it was essential to collect information about the main development stages, content and form of these assignments.

In addition my task was to describe basic principles of state expert review of design documentation, which is performed in order to check the compliance of developed documentation with requirements of Russian legislation and need to be complete before the beginning of construction process.

The main problem during thesis writing was connected with absence of agreed form and way of design assignment development. Its structure is not regulated by any unified document and in practice form is just agreed between different design departments or defined by internal rules of design organization and depends a lot on its design expertise and project specifics. The main information was gathered by summarizing information from the already performed projects and by interviewing several specialists.

Data concerning examination of design documentation was taken from the various regulative documents and from the web-pages of companies, which specialize in customer's design technical support and preparation of design documentation.

As a result of this thesis scheme of process algorithm of assignment submission procedure has been composed and content of initial data for every particular type of assignment has been described. Also main regulative documents and requirements to the content, structure and appearance of design documentation submitted to state expert review has been specified together with the main stages of state examination and re-examination procedures.

KEYWORDS: Equipment suppliers, Design assignments, Related design departments, Initial data, Initial requirements, Construction assignments, Design documentation, State expert review

CONTENTS

1 INTRODUCTION	5
2 DESIGN ASSIGNMENTS	7
2.1 Design assignment for development of individually tailored equipment..	9
2.2 Design assignments submitted to related design departments.....	12
2.2.1 Construction assignments	19
2.2.2 Assignment for mechanization of repairing and installation processes	32
2.2.3 Assignment for designing of heat, supply and ventilation systems	33
2.2.4 Data for designing of fire protection measures and fire extinguishing systems	37
2.2.5 Assignments for designing of water supply and sewage systems	39
2.2.6 Occupational safety requirements. Assessment of the emergency.	40
3 STATE EXPERT REVIEW OF DESIGN DOCUMENTATION.....	41
3.1 Common information about legislation base.....	42
3.2 Content, appearance and scope of design documentation.....	43
3.3 Engineering surveys	48
3.4 Procedure description of state expert review.....	50
3.5 Re-examination procedure	53
3.6 Cost of expert review implementation.....	54
CONCLUSIONS.....	56
CHARTS	58
TABLES.....	58

APPENDICES

Appendix 1. Blank form of assignment for designing of utility and drinking water supply system for industrial consumers

Appendix 2. Blank form of assignment for designing of the equipment cooling system

Appendix 3. Blank form of logbook for registration of assignment submission/receiving

Appendix 4. Blank form of application request for documentation submission to the state expertise

1 INTRODUCTION

This bachelor's thesis work was written for ECO Environment Ltd. Oy, which is a subsidiary company of Econet Ltd Group located in Helsinki. Company offers wide range of solutions in the sphere of planning, project management and construction of municipal and industrial waterworks and wastewater treatment plants, biogas plants and waste treatment facilities.

Two basic types of contracts can be associated with the projects, realized by ECO Environment Oy during realization of projects in Russia:

- "Turnkey" deliveries
- Equipment deliveries

In case if contract agreement stipulates only design and package supply of equipment then process of construction and commissioning into operation is performed by the customer, while equipment supplier should control this process by performing the installation supervision.

During realization of the "turnkey" projects supply company is responsible for the transfer of fully completed object to customer before agreed due date and it performs every stage of construction and installation processes, various testing operations and commissioning into operating.

Because of such differentiation of performed projects it was necessary to analyze the following questions:

- 1) To investigate the process of design assignment development and to specify the type, preparation procedure and maximum volume of the initial data, which should be provided to the customer and related design departments (in case of equipment supply projects)
- 2) To describe the main stages of the state expert review of design documentation (Expertise) in Russia in order to find out the possible difficulties at this stage of project development (in case of «turnkey» projects)

Two different projects were used as the basic information sources. First of them is a “turnkey” project of technical re-equipping and modernization of existing state regional power plant Kirishskaja GRES, which is located in the Leningrad region at the distance of approximately 115 km to the south-east of St. Petersburg, Russia. In addition to installation of new water treatment equipment and replacement of old equipment several architectural and construction decisions were made during renovation process. These operations were realized by YIT Environment Oy. Few years after the project beginning this company, which performed functions of general designer and general contractor was purchased by the Econet Group. Subcontract design company OOO “Evist” due to subcontract entered into with YIT Oy was responsible for:

- Performing condition survey of existing structures and making technical conclusion about condition of load-bearing structures
- Development of project and engineering documentation of construction part of the project according to the Russian norms and standards and coordination with customer
- Receiving of positive conclusion of state expertise for developed project documentation and engineering survey results concerning strengthening of existing concrete and steel structures, construction of new equipment foundations and repairing of drainage system

Another project, which was used for the referencing purposes is a project of South-West thermal power plant located in Saint-Petersburg, Russia. In this case the procurement and design contracts were signed between ECO Environment and general contract company OAO “Stroytransgas”, which performs the construction and reconstruction of industrial and infrastructure objects, primarily in the oil, gas, and electric power industries. Functions of the main design organization were realized by the Atomenergoproekt Saint Petersburg Research and Design Institute (AEP SPb).

For better understanding of existing problems, which took place within project implementation, several specialists on the part of general contract and general design organizations were interviewed during visiting of the building site.

The main purpose of the interviewing was to collect the information about development design assignments and content of initial data, provided to related design departments of main design organization.

2 DESIGN ASSIGNMENTS

Two basic types of information data are used during design process: external and internal. Volume of internal information depends on the designers' experience and qualification, volume of the technical archives and libraries and consists of the typical and individual projects, design standards and instructions, catalogs of produced equipment, data used during interaction between various design departments. External information "comes from outside" and consists of the data about the particular project and contains information (initial data and requirements) submitted by customer, different research organizations and equipment and material suppliers.

Every design process arises from the processing of the external and internal information collected by the project participants. And the main factor which influences the quality of the final project is the level of feedback between customers, main and subcontract design organizations, equipment suppliers, general and subcontractors. High-level feedback should be provided on every stage of project development by means of constant verification of the intermediate and final results with the ultimate goals of project development.

These ultimate goals should be formulated in the design assignment by documentary fixing of basic project parameters and key features according to customer's wishes and requirements of supervision organizations or related design departments. In context of the subcontracting design works, which includes project activities of various design departments, above-mentioned requirements should be fixed up by the corresponding agreements for the subcontract designing, surveying and construction works.

Several types of design assignments can be defined depending on the specifics of designed object. (Table 1)

Table 1 Organization of the design assignment preparation procedure

№	Type of design assignment	Assignment developer	Assignment receiver
1.	Design assignment for the capital construction / reconstruction object	Customer	Main design organization
2.	Design assignment for development of the individually tailored equipment	Main design organization	Equipment manufacturer/ supplier
		Subcontract design organizations	
		Process-specialized departments of the design organizations	Process-specialized equipment- engineering department of the design organization
3.	Design assignment for object's particular functional and engineering systems and elements	Main design organization	Subcontract design organizations
		Subcontract design organizations/	Subcontract design organizations/
		Process-specialized design departments	Process-specialized design departments
		Equipment supply companies	Main design organization or customer (for the following submitting to subcontract design organizations and departments)

Table 1 also lists main participants of assignment preparation procedure. The main emphasize in this thesis is made on the third type of assignment, however basic principles for development of assignment for development of the individually tailored equipment are provided. The point is that it can contain initial data about equipment, requested by the main design organization at the pre-design stage of project implementation.

2.1 Design assignment for development of individually tailored equipment

All the delivered equipment for the purposes of discussion can be divided into two basic groups:

- individually tailored equipment designed according to the specific project requirements (decarbonators, clarifiers, etc.)

- standard equipment (compressors, centrifuges, pumps, etc.)

Individually tailored equipment includes both prolonged and short manufacturing cycle equipment. First one is manufactured within the performing of installation process, while second type is delivered pre-assembled. Irrespective of these differences the same initial data is needed for equipment selection.

Assignment for capital-investment object in most cases does not contain any detailed information concerning requirements to the object's particular functional and engineering systems or processing equipment. In order to define customer's wishes at the pre-design stage of project implementation special technical requirements to designed object should be prepared.

Common practice at this stage of pre-design project implementation is to send to customer or main designer equipment configuration data sheets and equipment catalogs. Filled up data sheets together with equipment general view drawings and passports describes key requirements to equipment, its capacity and act as a basis for the further process planning and equipment designing

Background analysis shows that design organization during cooperation with equipment supplier usually makes a "formless" initial data request in order to get all the necessary information. "Formless" means that form and content are defined only by the internal rules of design organization and depends a lot on its design expertise and project specifics.

However several advisory documents define the appearance and approximate content of this request and enact as recommendations for its preparation. One of them is "Guidelines for preparation of initial requirements on the development

of detailed engineering documentation for individually tailored equipment” (MR 21.03-99), which developed as application to the SNiP 11-01-95 “Instructions on the procedure of development, coordination, approval and composition of design documentation for construction of enterprises, buildings and structures”

These guidelines specify type, preparation procedure and maximum volume of the initial requirements on development of design documentation for construction of individual tailored equipment. In other words after equipment is selected by customer or main designer, initial requirements should be provided by main design company and then customer’s obligation is to submit them to the company, which designs and delivers equipment.

By submitting initial requirements design organization formulates what should be taken into account during designing of delivered equipment in order to create the interconnected design solutions. Supply company in return should provide equipment passports and other requested design data or otherwise the confirmation that everything will be made in accordance with the set requirements. Rests of requirements are set by customer with assistance of equipment designer and all these requirements should be mentioned during assignment preparation. In general case initial requirements should consist of (MR 21.03-99, §5.1):

- 1) general information about equipment
- 2) technical requirements
- 3) requirements to the initial data content
- 4) constructional requirements
- 5) delivery requirements
- 6) installation requirements

For example the following construction requirements should be taken into account by equipment supply company upon the request of main designer (§ 5.5):

- requirements concerning applied fastening methods (foundation screws, embedded fittings, etc.)

- requirements concerning equipping of the supporting parts with the special structural elements, which provide the reducing of negative effect on the foundations (vibration absorbers, special supporting elements, etc.)
- requirements concerning simplification of foundation construction and limitation of its penetration depth
- equipment location requirements, which provide the free ranging capability for the lifting and transporting equipment during installation, maintenance and repair and help to avoid of the formation of inaccessible areas

The content of abovementioned sections depends mainly on the individual features of developed equipment and some sections can be excluded or added.

The key point is that MR 21.03-99 defines the content of maximum initial data volume provided by equipment supply company to the main design organization:

- 1) Initial data for the design of construction part of the project
 - a) Dimensioning equipment specifications (including maintenance platforms)
 - b) Locations and sizes of all the necessary transport accesses and openings in the envelope structures which provides the free transfer of large-sized equipment and its modules to the place of installation
 - c) Distribution of the floor loading with allowance for the transporting and erection loading during installation
 - d) Foundation levels
 - e) Depth of all the necessary floor channels, tunnels, drainage pits, etc.
 - f) Information about installation of the embedded fittings, anchoring and fastening elements, platform floorings and railings
 - g) Initial data concerning loading on foundations
 - h) Foundation bolts' marking and positioning relative to the equipment
 - i) Location of maintenance platforms, railings and other metal structures

- 2) Initial data for design of the water supply system, process air supply system, steam supply system and other systems, which provides the supply of necessary energy resources
- 3) Initial data for design of the electrical part of the project
- 4) Initial data for design of the instrumentation and automation system
- 5) Initial data for development of the fire protection measures
- 6) Initial data for design of the repairing and tool departments
- 7) Initial data about equipment vibration and noise level
- 8) Equipment operating modes
- 9) Required amount of the maintenance staff
- 10) Initial data concerning equipment's environmental safety

2.2 Design assignments submitted to related design departments

Wide range of specialists takes part in the complex development of the industrial objects and they should work in a close interaction in order to avoid any delays and subsequent project changes. Structure of design organizations depends on its specialization. The following scheme lists main design departments which take part in industrial projects implementation (Figure 1).

Chief Project Engineer (GIP in Russian) acts as a "linker" between management personnel of custom organization and design organization. He is responsible for receiving and processing of initial data from the customer and its submitting to the executing specialists. Moreover, he performs coordination functions and controls the process of assignment submission between departments, makes conformity assessment of assignment appearance and content, check quality of transferring initial data and its timely preparation.

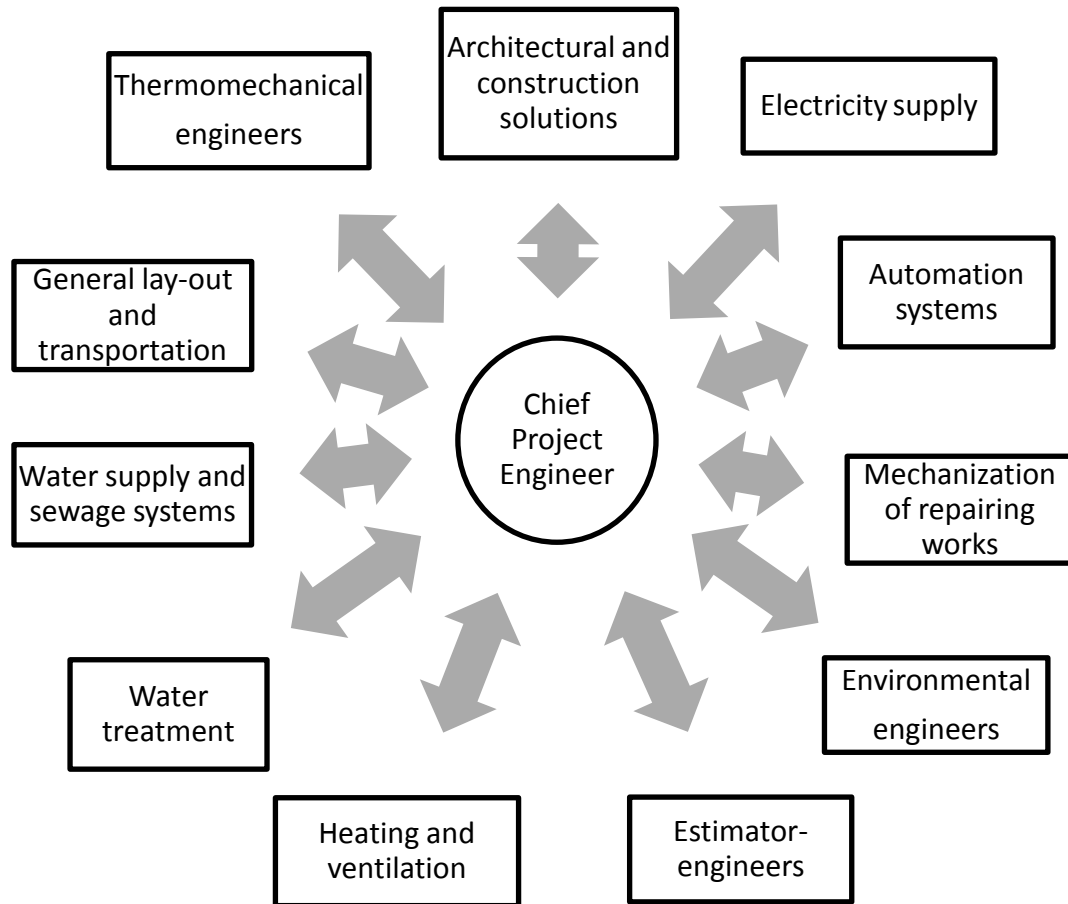


Chart 1. Schema of interacting process between different departments of design organization

Also several combinations of above-mentioned departments are possible in case of joint implementation of project parts. At the same time each of these departments can be represented as an independent subcontract organization, acting in accordance with agreement signed with main designer or customer. Main design organization performs the implementation of the general parts of project and also has responsibility for realization of the entire project, including sections developed by the subcontract design organization.

Well-organized coordination between main design and various subcontract design organizations and departments cannot be realized without timely prepared and exactly composed design assignments. In big and experienced design companies this process is regulated by the special local standards,

which define the structure, form, content and process of development of project design and detailed documentation, drawings and internal documents.

The common way for such companies to ensure that provided design engineering services meet customer's needs and that design process is organized properly is connected with receiving conformity certificate according to international standard ISO 9001:2008 "Quality management systems – Requirements". Registration to ISO 9001 is realized by an accredited certification body and this procedure helps company to create well-functioning quality management system. Internal standards developed according to ISO 9001 should define procedures of document development, coordination and approval, registration and distribution inside the design organizations, its correction, interval updating and archivation. Also special instructions must be developed to make employees aware of documentation workflow system.

In case of South-West Thermal Power Plant project implementation main design organization developed its document management system according to ISO standards. This is one reason why all the necessary blank forms of assignments were supplemented with clarifications on the way of their completion. Instructions contain the following information:

- list of design departments, which should be provided by assignment
- list of design departments, which should develop the assignment
- applied marking systems
- essential standards and normative documents
- list of drawings necessary for attachment

As was mentioned structure of the assignment is not regulated by any unified document. But in common case it consists of drawings, specifications of equipment and materials, requirements to the working facilities, structures and engineering networks, some calculations if necessary and accompanying letter, which should contain the following information:

- name of object and type of assignment
- name of receiving department

- name of developing department
- check list of attached drawings
- additional explanatory information
- date of assignment transfer
- date of assignment performance by developing department

Textual part of assignment includes summary tables and additional instructions in a form of comments supplemented to the table forms or mentioned in attached drawings. Graphical part should be prepared according to requirements of the Russian system of design documentation for construction (SPDS) and unified design documentation system (ESKD).

Examples of provided forms and are represented in the Appendix 1 and 2 of the thesis. First one is made according to execution rules set by the GOST R 21 1101-2009 “Main requirements for design and working documentation”. Dimensions of all the necessary stamps, type fonts and forms’ content are defined by the Appendixes Г, Ж, И, К, Л, М, Н of this document. Second example of assignment is also developed as an internal document of qualified project organization, but in this case no special requirements were set to assignment appearance.

Main difficulties are connected with untimely transferring of assignments and their incompleteness. That is why special logbooks for both submitted and received assignments should be composed (Appendix 3) in order to determine the participants’ responsibilities.

Another difficulty is to provide the organizational support by developing of the step-by-step guide of assignment transferring process. The process algorithm of design assignments submission between different design departments is provided on the scheme (Chart 2).

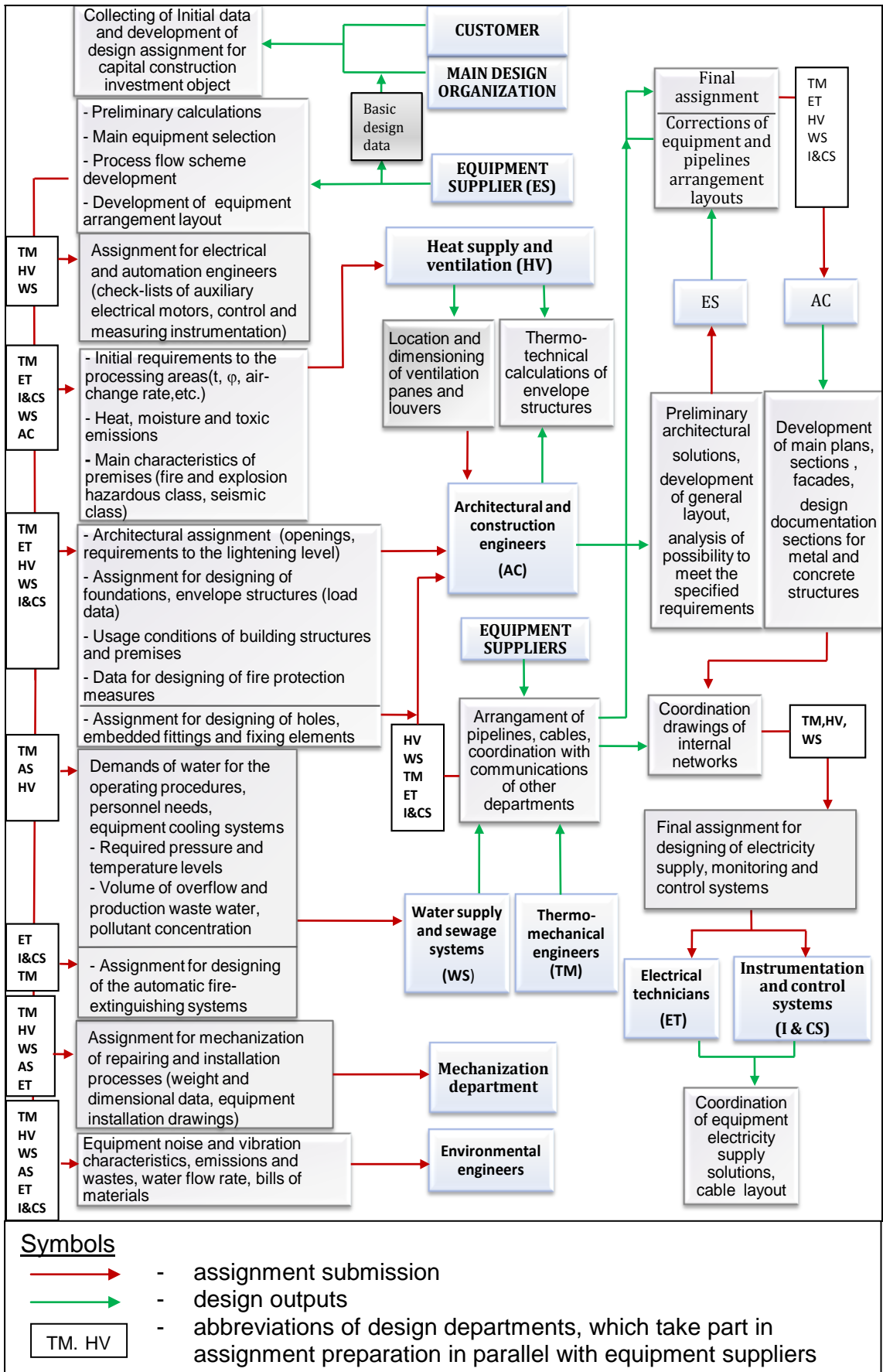


Chart 2. Schema of design assignments submission process

This scheme illustrates my view on the initial data providing system between related design departments. Of course it is next to impossible to show the coordination process in a full measure by using only one scheme and everything depends on project's scale and purposes. But for example in case of implementation of water treatment project for newly constructed boiler houses this scheme defines quite well the sequence of operations and names of receiving and developing departments as well as approximate assignment content. In fact the whole process is more complicated and includes more negotiations and corrections between departments.

The main emphasize is made on the assignments that need to be provided by the water treatment specialists ("Equipment suppliers"). Also some intermediate designing results which can act as a basis for the next stage of assignment development are shown.

Only one information source which describes the sequence of operations during assignment preparation in a more or less precise way was found. In spite of its old publication year this handbook (Grinberg, "Designing of chemical production facilities") is still quite often mentioned as a reference source and can be useful during designing of industrial objects. According to it, after final correction of equipment arrangement, completing of process flow scheme and process design calculations the following actions should be done (Grinberg,p.230, 1970):

1. Development and submission of first assignment for designing of:
 - Instrumentation and control system
 - Electric supply
 - General lay-out
 - Water supply and sewage systems
2. Development of the first assignment for architectural and construction department
3. Approval of the first assignment with departments of:
 - Instrumentation and control system (I&CS)
 - Electricity supply

- External networks
- General layout
- 4. Submission of the first assignment to architectural and construction department
- 5. Submission of assignment to estimating department
- 6. Arrangement of main pipelines
- 7. Approval of intermediate architectural and construction drawings
- 8. Development of equipment local piping system
- 9. Development and submission of second assignment for designing of :
 - Architectural and construction part
 - External networks
- 10. Energy supply system
- 11. Development of assembly and process flow diagram
- 12. Development and submission of second assignment for I&CS engineers
- 13. Approval of drawings for designing of :
 - Initial construction works
 - Water supply and sewage systems
 - Heat and ventilation system
 - Electricity supply and lightening systems
- 14. Final development of equipment and pipelines' installation drawings
- 15. Development and submission of final construction assignment
- 16. Approval of intermediate construction drawings (design documentation sections for metal and concrete structures)
- 17. Development of pipelines' log books
- 18. Transmission of installation drawings to the I&CS engineers
- 19. Completing of installation drawings
- 20. Final approval of construction drawings
- 21. Development of specifications of pipelines' elements
- 22. Development of drawings of fixing elements, embedded fittings
- 23. Submission of assignment to estimating department
- 24. Development and submission of assignment for designing of equipment and pipelines' thermal insulation system (if necessary)

After completing of graphic documentation and laying down of specifications all the departments should submit necessary data to estimator-engineers upon on the demands of the customer. At the same time all the specialists develop the textual part of main explanatory note and submit all the documentation to the chief project engineer. Every assignment should be approved and signed by the Chief Project Designer and the head of receiving department.

2.2.1 Construction assignments

Construction assignments contain initial data and initial requirements for designing of the appropriate architectural-building solutions. The following specialists are responsible for assignment submission to architectural and constructional department:

- Water treatment specialists
- Thermo mechanical engineers
- Electrical engineers
- Designers of transporting and mechanization processes for performing installation, maintenance and repairing works
- Automation engineers
- Sanitary technicians (designing of heating, ventilation, water supply and sewage systems)

For buildings and complex engineering structures construction assignments should be prepared in several stages. Preliminary construction assignment should consist of:

- Floor plans and cross sections (1:50, 1: 100 or 1:200) together with the equipment arrangement and equipment specifications
- Facility specifications and application purposes of premises
- Equipment load data
- Data concerning possible loading on the floors and platforms from pipelines and equipment units, dismounted during repairing and maintenance works
- Data about fire and explosion categories of premises and their usage conditions

Equipment arrangement and installation drawings could not be prepared without development of the process flow scheme, which is also need to be submitted upon the request of main design organization. This scaleless scheme is developed by processing engineers and acts as a graphical reflection of sequence of treatment processes and shows the main flow courses. It should contain the following essential information:

- Processing equipment and pipelines represented in a form of accepted conventional symbols (with specifying of identification marks)
- Main characteristics of pipelines (diameter, operational and maximum possible pressures and temperatures)
- Locking arrangements (valves, taps, gates)
- Primary instrumentation and measuring devices (instrument valves, metering orifices, counter registers, etc.).

Process flow scheme should be supplemented with the following documents:

- Equipment schedules (identification lists), which include information about amount of equipment, individual equipment number and nomination, drawing indication, key features and structural material
- Pipeline lists
- Chart of applied conventional symbols

Preliminary equipment arrangement layout is prepared after process flow scheme development. Architectural and construction department analyzes its compliance with rules set by the normative construction documents and technical regulations, check out if proposed arrangement conforms to the planned or existing building solutions (positioning of supports and braces, engineering networks, building framework and foundations, accessibility of equipment from maintenance point of view, etc.).

Final equipment arrangement drawings should contain:

- 1) Building coordinate axes and distances between them
- 2) Equipment outlines according to developed equipment drawings or data from equipment catalogs provided by manufacturer (external diameter, total height, positioning of supporting legs and hatches, outlet and inlet connecting tubes, etc.)

- 3) Equipment orientation and dimensioning to the construction lines, walls or already plotted units in two main directions
- 4) Equipment identification marks (applied alphanumerical codes)
- 5) List of equipment
- 6) Equipment relative height positions, height marks of floors and platforms
- 7) Solutions concerning installation and fixing methods (foundations, cantilevers)
- 8) Lifting equipment for process needs
- 9) Location and dimensions of maintenance and repairing platforms,; mounting holes and pads, sizes of maintenance accesses
- 10) Allowable installation loads on the platforms and building structures
- 11) Location of the emergency exits

Common practice is to combine plans with equipment arrangement and installation drawings at the same lists. In this case drawing identification mark is given according to installation drawing. In the absence of initial architectural drawings arrangement is developed without dimensioning to construction lines, just necessary areas and passageways must be specified.

Attached specifications of equipment and pipelines should be made in accordance with GOST 21.110-95 "Rules of developing specifications for equipment, products and materials".

Equipment arrangement layout should be always improved and updated. It may be necessary to re-arrange equipment into groups according to the dust and noxious emissions, vibration level and aggressive action to the building structures, to make allowances for the standard dimensions of spans, openings, passageway and thickness of envelope structures according to the weight of equipment, to avoid structural interferences with piping elements.

Not only builders are interested in assignment coordination process. Plans and sections with specified equipment and pipelines arrangement among construction department should be submitted to the thermo mechanical engineers, sanitary and electrical technicians, automation and installation

engineers. The main point is to consider the positional relationship of various engineering networks. For example electrical cables and hot-tempered pipelines shouldn't be adjacent to each other. To avoid it special combined plans of networks of engineering and technical supply must be prepared by Chief engineer or cooperatively by several departments. This is also the reason why every drawing should contain special coordination table. This table includes 4 columns (Appendix1, p.1):

- Name of design department
- Personal information of reviewing person
- Signature
- Date

So after drawing is provided to related design departments they should ensure that there are no any collisions in proposed design solutions. In case if something goes wrong and it is necessary to make any alterations at the later stages of designing or construction the responsibilities will be shared between developing and reviewing departments according to information in this table or in the special logbooks mentioned earlier. All the construction drawings containing design solutions performed according to the requirements of submitted assignment should be approved by its developer.

After preparing of preliminary assignment general arrangement of equipment is defined more exactly, construction engineers consider type of the main structural elements and plans the location of main and auxiliary facilities.

Process engineers supplement graphical part of assignment with the following information:

- Processing substances and their hazard classes
- Fire-explosion classes of the processing areas and premises
- Equipment noise level during exploitation
- Data concerning presence of the permanent or temporary work stations
- Necessary level of the natural and artificial lightening, which provides the optimal working conditions for the operating and maintenance engineers

Requirements to the lighting system should be considered for the several operational regimes:

- general lighting level when nobody is working in the premise
- working lighting level for operating conditions
- emergency lighting in case of electricity supply system failure

Table 2. Initial requirements to illumination measured on the floor level

Item№	Equipment or facility location	Unit of measure	Illumination level	Operational regime	Comments
1 2 ... n	Name of equipment, facilities, floor level	Lux	Not less than...	General lightening Working lightening Emergency lightening	Type of light source, maximum height dimension of equipment, etc.

Solutions concerning artificial lightening system are developed by electrical engineers. That is why this department should be provided by initial requirements to the illumination level (Table 2).

Standard values of natural and artificial illumination factors for industrial buildings are defined by the building code SP 52.13330.2011.

Requirements to the premises' outside glazing system can be submitted in order to provide for the necessary natural lighting level and blast openings, which reduce explosion pressure and increase the building resistance during explosion situations. These openings must be provided, for example, in such objects as boiler stations or thermal power plants, which quite often can be met among the projects of thesis client company.

Equipment load data, which is needed for designing of foundations and envelope structures is usually provided in a tabular form (Table 3) and contains information about equipment dead (permanent) loads and imposed (temporary) vertical and horizontal loads taking place during installation and repairing works.

Table 3. Equipment load data

Item No.	Load designation	Point of load application	Characteristic load, tones			Overload factor	Number of loads, pcs.	Comments
			Static load		Dynamic load			
			Load designation	Long-acting temporary load	Short-time load			

Execution recommendations:

Column 2 - Name and type of equipment

Column 3 - Vertical position level of equipment

Column 4 - The same designation system as on construction drawings should be used ($P_1, P_2 \dots P_n$)

Column 5 - Operational weight of assembled and fixed equipment (unit weight of equipment components+ agent weight considering its consistency)

Column 6 - Operational weight of temporary assembled equipment (unit weight of equipment components + agent weight considering its consistency)

Column 7 - Dynamic loads should be provided for the equipment moving parts (electric motors)

Column 8 - Weight of electric motors

Column 9 - The following values of overload coefficient are used:

- $\kappa=1,05$ - for capacitive equipment
- $\kappa=1,2$ - for pumping equipment
- $\kappa=4,0$ - for electric motors

Column 11 - Equipment marking, degree of filling with the processing substances, etc.

In order to select the appropriate interior finishing of ceilings, floors and walls

and to provide the necessary inside temperature and humidity level construction engineers request information about usage conditions of premises and building structures.

Usage conditions of workshops

- 1) Name of premise
- 2) Premise's location or marking (according to agreed marking system applied at the room-by-room schedule), floor level
- 3) Floor area, m²
- 4) Volume, m³
- 5) Required frequency of maintenance (permanent or temporary)
- 6) Relative humidity level (φ , %)
 - a) For the normal operational regime
 - b) In case of emergency conditions
- 7) Temperature maximum and minimum levels (t , °C)
 - a) For the normal operational regime
 - b) In case of emergency conditions
- 8) Pressure (p ,MPa)
 - a) For the normal operational regime
 - b) In case of emergency conditions
- 9) Flooding
 - a) Floodable line level
 - b) Water temperature (t , °C)
 - c) Time span of the water level existing (t , h)
- 10) Fire hazard class
- 11) Mechanical effects (data about applied lifting and transporting mechanisms)
- 12) Chemical load level (low, medium, high)

Potential value of floodable line level should be mentioned to consider protective covers of building structures, location of drains and drain pits, water barriers, emergency pumps and chose properly relative height positions of equipment.

Usage conditions of building structures

- 1) Name of premise
- 2) Location
 - a) Marking, coordinate axes of premise/operating area
 - b) Floor level
- 3) Floor area, m²
- 4) Maintenance class of premise
- 5) Key characteristics of the solid and liquid mediums
 - a) Name or chemical formula
 - b) Concentration, grams per liter
 - c) Temperature (t, °C)
- 6) Degree of aggressive mediums' influence on the floor structures
(insignificant, significant, strong or very strong influence)
- 7) Flooding
 - a) Floodable line level
 - b) Water temperature (t, °C)
 - c) Time span of the water level existing (t, h)
- 8) Characteristics of the gas-air mediums
 - a) Name or chemical formula
 - b) Concentration, grams per liter
 - c) Temperature (t, °C)
 - d) Relative humidity (φ, %)
- 9) Mechanical effects on the floor structure
- 10) Type of floor cleaning procedures
- 11) Special operational conditions (f.e. requirements to the floor surface finishing)
- 12) Mechanical effects (f.e. effects of lifting and transporting mechanisms)
- 13) Availability of the drain pans and protection covers (with an indication of the flange edge level)

As can be seen from the above, preliminary construction tasks should contain information, which is needed to define the general architectural and civil engineering concepts, to choose the appropriate building structures and to make

the structural analysis, to develop the interim construction drawings (floor plans, cross-sections and façade drawings, formwork drawings for the reinforced-concrete bases and equipment maintenance structures or installation diagrams in case of the metal equipment bases and maintenance structures).

Intermediate construction assignment should contain schematic drawings of equipment foundations, assignment for mechanization of installation process, assignment for designing of pits, canals, pipeline trestles, supporting structures and mounting facilities, maintenance platforms and access stairways.

Most commonly data concerning maintenance platforms is provided by equipment supplier or manufacturer, who should develop special assignment for the structural steel design department and supplement it with a sketch drawing of platforms. Drawing should contain information about characteristic surface load (in most cases it is equal to 200 kg/m^2) and dimensions to the construction lines. More detailed drawings are developed by the steel structural department, if necessary.

Final construction assignments are developed in a graphical form after completing of installation process design, developing of equipment and pipelines' installation drawings. They define more exactly the data given in preliminary and intermediate assignments and also provide the additional information necessary for the final development of the project construction part. Final assignments should contain information about location and sizes of the necessary holes and openings (pipeline ports), embedded fittings, anchoring and fastening elements.

Assignment for designing of equipment foundations

In addition to submitted load data (Table 2), final equipment and foundation arrangement drawings with indication of equipment weight loading during operating regime and value of the dynamic factor the following information is usually requested:

- 1) special instructions concerning sequence of operations, applied materials and construction methods for foundation works implementation
- 2) equipment passports and installation drawings of equipment manufacturer with specification of foundation bolts location, their diameters and lengths of their projecting and threaded parts, steel types

The maximum volume of the rest of the provided data is connected with designing of foundations with dynamic loads, so this case was mentioned as an instance.

In case of dynamic loads foundation vibrations are transferred both to the foundation soil layers and back to the equipment. This can lead to additional settlement of foundation or to unacceptable unbalancing of the equipment rotation parts. The main causes of vibration occurrence depend on the following factors:

- unbalancing condition of equipment moving parts
- pressure jumps inside processing equipment and pipelines

All the equipment associated with potential vibration risks must be placed on the individual foundations or separated from the adjacent building structures with special vibration-damping materials and mechanisms. This refers for example to equipment with rotated parts, such as centrifuges and centrifugal pumps, compressors, air blowers, ventilators.

According to the SNIIP 2.02.05-87 "Foundations of machines with dynamic loads" the following initial data should be provided for designing of above-mentioned foundations:

- Equipment technical features (name, number of revolutions per minute, capacity, total weight and weight of moving units, equipment kinematic scheme together with dimensions of moving masses, inertia moments occurring unbalancing moving parts)
- Static load values and points of load application

- Data concerning dynamic loads for the normal operation conditions and for emergency mode (vibration amplitude, frequency, oscillation phase, time-varying law, points of load application and load direction)
- Loads on the anchoring bolts, including dimensions of the load-application areas
- Data concerning availability of the factory installed vibration insulation mechanisms (data about dynamic loads should be developed taking into account technical features of these mechanisms)
- Requirements to foundation deformability (ultimate strain values, foundation settlement, tilt and deflection values, amplitude of vibration, etc.). These limitations are set in order to provide necessary processing technology or equipment operating conditions, or in case if some of the high-precise and vibration-sensitive equipment is located nearby
- Limitation requirements to the relative deformations of the different equipment parts
- Equipment arrangement data (in order to know if it is necessary to design freestanding individual or combined foundations for group installation)
- Characteristics of the base plates and frames for the arranged equipment, including information about type of their connection to foundations
- Dimensioning foundation drawings, specifying grout application level and drawings of the fastening and anchoring elements, embedded fittings, etc.
- Drawings of the auxiliary equipment and supply lines, located close to the foundations or pass through it (including location and dimensions of hollows, cavities, plumbing and electrical penetrations, etc.)
- Special requirements concerning protection of foundations and pits against ground water and aggressive action of lubricating and oil materials
- Data about loads which take place in case of equipment heat deformations
- Data concerning installation loads and sizes of their transferring areas

Total aggregate load, which is equal to the worst combination of dynamic and static forces, should be mentioned in foundation arrangement drawings. In case of leg supports this load must be divided into several parts to show the influence on each particular foundation.

Equipment technical features in most cases can be found in equipment passports provided by equipment manufacturer. Vertical and horizontal dynamic forces for equipment with rotated parts can be also calculated by using the following formula (SNiP 2.02.05-87, §2.7):

$$F_{n,v}=F_{n,h}=\mu \sum_{k=1}^s G_i$$

s – amount of rotors, pcs

G_i – weight of rotor, kN (or ton-forces)

μ - coefficient of proportionality, defined according to the Table 4

Table 4. Coefficient of proportionality for evaluating of components of equipment dynamic forces (SNiP 2.02.05-87, §2.7)

Machine type	μ
Electrical machines with rotation speed n _r , r/min: less than 500 from 500 to 750 from 750 to 1500 more than 1500	0,1 0,1-0,15 0,15-0,2 0,2
Centrifuges, d- rotor diameter, m	$\left(\frac{n_r}{1000}\right)^2 d$
Centrifugal pumps	0,15
Ventilators	$0,8 \left(\frac{n_r}{1000}\right)^2$, but not less than 0,2

Assignments for designing of holes and embedded fittings

Embedded fittings are placed in envelope structures and foundations for fixing of equipment, pipelines, cables, elements of monitoring and control systems (f-

e- control switch boards) and supporting metal structures. Usually it should be done before the beginning of concreting works, but methods of installation into the already hardened concrete structures are also widely used.

The main purpose of assignment preparation is to reduce the volume of mortising works during installation of equipment and pipelines or cable placing. During designing of envelope structures builders should consider the location and sizes of necessary openings taking into account their influence on the load bearing capacity of structures. Assignment should be also submitted to the installation engineers, for example in case of networks re-arrangement at the later stages of project development when construction works are completed. In this instance new holes should be shown on the plans of engineering networks and data about all the unspecified items should be given to the estimator-engineers, which in turn should foresee additional payments for installation engineers.

Assignment for designing of floor and wall holes is usually developed beginning with 50-100 mm dimensions. Otherwise it is very likely that during installation process it will be too complicated for workers to pass the pipelines or cables through the envelope.

In case of necessity to use non-standardized fittings and concrete inserts equipment passports should be supplemented with their drawings and special requirements to applied materials, durability, configurations and mass of details, installation methods and anticorrosion protection. Standard drawings are submitted upon designer's request. Otherwise drawings of fastening and embedded elements should be prepared by subdividing part of construction department responsible for designing of metal structures.

Location of embedded elements for equipment installation should be mentioned in the foundation layout drawings and it is necessary to "tied" it with foundation reinforcement. In this case together with submitting of equipment load data and arrangement layout it is necessary to clarify the location of equipment supports

and way of equipment fastening to the floor or foundations. That is why assignment can be developed only after completing of equipment and pipelines' installation drawings, which specifies type of building structures for installation of equipment and supports, mounting dimensions and distances between equipment parts and building structures, special protection measures (f.e. against influences of aggressive mediums). Also technical requirements to applied installation methods and materials should be provided at the drawing area.

In case of self-implementation of electrical and automation part of water treatment systems by equipment suppliers in the attached drawings should be mentioned (guidelines RM 25-251-90) :

- embedded fittings for installation of measuring and control devices, control panels, electrical cables
- embedded pipes for enclosed electrical wirings, cable raceways and trays, location of cables' entrance points to the premises
- mounting holes, for handling of electrical equipment and mounting facilities

Common practice is to combine the location plans of holes and inserts with schematic layout drawings of equipment and networks. The main thing is to show dimensioning of inserts and holes to construction lines or building structures, distances between pipeline's embedded fittings (depending on pipe diameter and presence of thermal insulation).

2.2.2 Assignment for mechanization of repairing and installation processes

Assignment should be provided to the department, which ensures that necessary conditions are in place for performing of handling operations during equipment maintenance and repairing works. Above-noted department makes provision for designing of the repairing platforms, maintenance walkways, special lifting tools and hardware, installation of lifting and transporting mechanisms of required capacity.

In addition to the equipment arrangement layout, explanatory note with information about potential damages and units that should be replaced during technical maintenance should be provided. It should contain the weight and dimensional data on the equipment and its changeable units, which are need to be dismantled in case of repairing works. So the following data should be provided:

- 1) Ready assembled equipment
 - Name of equipment and its identification mark
 - Reference number (according to equipment layout)
 - Overall dimensions, mm
 - Weight, kg
 - Number, pcs
- 2) Separate units dismantled during repairing works
 - Name of equipment unit and its designation
 - Overall dimensions, mm
 - Weight, kg
 - Position of the centre of gravity (if necessary)
 - Lifting mechanisms planning to be used during installation
 - Special requirements to the installation works
 - Ground elevation marks

As a result sizes of repairing platforms should be enough for performing of units dismantling and cleaning without blocking of the pass ways, main and emergency exits. Floor structures, channels and building foundations must be designed with allowances for loading during equipment transportation to the place of installation, free access of transporting and lifting mechanisms .

2.2.3 Assignment for designing of heat, supply and ventilation systems

During designing of ventilation system priority goal is to reduce the amount of noxious emissions and to provide optimal working and operational conditions by keeping up of air-quality in the workshops. Assignment specifies the necessity of basic heating system designing, defines requirements to the climate of

working premises, level of heat and toxic emissions, requirements to air conditioning system. It should be submitted to design department responsible for designing of heat supply and ventilation system by the specialists, which design the following project parts:

- Water treatment
- Thermo mechanical
- Electrotechnical
- Water supply and sewage systems
- Transportation and processing operations
- Monitoring and control systems
- Architectural and construction solutions

In most cases assignment should be developed after the completion of the general equipment arrangement. In order to define heat emission from the electrical equipment it is useful to supplement it with the assignment for designing of the electrical supply system, which includes:

- Equipment arrangement layout with identification of applied types of electrical motors including electric drives units for control and stop valves and arrangement layout of electrical networks
- Check-list of auxiliary electrical motors with specifying of their key features (current type, voltage, capacity, rated motor speed, availability of overloading protection, number of starts per day, allowed time break in power supply)
- Data concerning amount of electric consumers, required power type

During approval of developed drawings designers should check availability of ventilation in all areas with noxious emissions, define places of possible intersections of ducts with processing equipment or pipelines.

The following initial requirements to the processing areas should be provided in textual part of assignment:

- 1) Name of premise

- 2) Premise's location or marking (according to agreed marking system applied at the room-by-room schedule), floor level
- 3) Key characteristics of premises
 - a) Fire-explosion and fire hazard classes (NBP 105-03)
 - b) Fire resistance degree according to SNiP 21-01-97 "Fire safety of buildings and structures"
 - c) Normal and incident pressure level
 - d) Maintenance class
 - e) Seismic class (in case of hazardous industrial objects or when construction is performed in the regions of high seismic activity.)
 - f) Number of permanent operational staff
- 4) Heat emissions, kilo-watt (minimum and maximum values)
 - a) For the normal operational regime
 - b) For the preventive maintenance regime
 - c) In the blackout conditions (de-energization regime)
- 5) Moisture emissions, kg/h
- 6) Emissions of potentially hazardous matter and toxic substances (name, unit of measurement and amount)
- 7) Clean-up requirements to the exhaust air (necessity of applying aerosol or iodine filters should be mentioned)
- 8) Air conditions in accordance with the process requirements (t - duration, h; minimum and maximum values of temperature, °C, φ -relative humidity, %)
 - a) For the normal operational regime
 - b) In case of emergency conditions
- 9) Additional requirements
 - a) required air velocity, m/s and air exchange rate, 1/h
 - b) allowable dust concentration, mg/m³ and particle sizes, μm
 - c) requirements to installation methods and materials of heating and ventilation systems,
 - d) demands for installation of fire dampers automatically closing in case of fire alarm activation

In case if heat emissions have a periodical nature it also should be mentioned in assignment.

Maintenance categories of working premises are defined by the sanitary regulations and standards (in Russian “SanPiN”), if any of such special regulations are provided for designed object. Usually these standards are developed for hazardous industrial facilities. For example SanPiN 2.6.1.24-03 sets sanitary requirements for designing and exploitation of nuclear power stations and according to it is necessary to divide all the areas with possible radiation effect into three categories (§7.2):

- nonoccupied areas, where only equipment and networks are located and presence of any operating staff is not allowed (I category)
- periodically attended premises, where only time-limited presence of staff is allowed (II category)
- permanently attended premises, presence of staff is allowed during the full-time working day

Name of noxious substances must be specified according to the GOST 12.1.005-88 “Occupational safety standards system. General sanitary requirements for working zone air” (Appendix 2, Maximum allowable concentrations of Harmful Substances in Occupational Air). This document contains general requirements to the measuring and control methods of the premise’s climate parameters and concentration of contaminants in the air.

Values of indoor environment parameters and required methods of heating and ventilation should be mentioned according to the SNiP 41-01-2003 “Heating, ventilation and conditioning”.

In cases when local exhausts for pumps, compressors and other processing equipment must be provided in order to avoid hazardous emissions the following initial data should be submitted:

- Amount of exhausts and air-flow through all the exhausts and through each taken separately m^3/h
- Content and characteristics of hazardous emissions (dust, gas, vapor, etc.) and their amount g/h (g/l)
- Emission method of disposal and dimensioning of the local exhaust pipes

- Presence of air-vent unit supplied complete with equipment and its brief description
- Requirements to amount of incoming air (into equipment)

2.2.4 Data for designing of fire protection measures and fire extinguishing systems

Initial data required for development of fire protection measures should consist of information about structural and spacial layout decisions, production technology solutions with description of fire hazardous substances and materials, information about the interior finishing of the premises.

Fire and explosion hazard class of workshops can be defined according to building code SP 12.13130.2009 or fire code NPB 105-03 “Determination of categories of rooms, buildings and external installations on explosion and fire hazard”. According to these documents all the premises are divided into the following classes: A, Б, B1 - B4, Г and Д (descending ordering according to the hazardous level). In order to define this class information about equipment fire load should be submitted. (Table 5)

Table 5. Equipment fire load data

Item №	Equipment location	Unit of measure	Load value	Fire loading source
1 2 ... n	Name of premise, floor level	MJ/m ²	g	Name of materials or processing matters, with specifying of equipment, pipelines or networks in which they are used, total mass,kg

Fire load value is measured in MJ/m² and shows the amount of heat emissions per unit area in premises in case of fire situation. As far as water treatment equipment by itself doesn't influence a lot on the fire risk level the main fire load

differs according to the amount of electrical equipment, instrumentation and automation devices, type of applying insulation materials. Fire load from the fire hazardous processing substances also should be taken into account, for example load from ion exchange resins using in the systems of ion-exchange technical water treatment. For mixtures of matters or materials it is allowed to define target values only with due to the most hazardous component:

$$g = \frac{Q}{S}, \quad Q = \sum_{i=1}^n G_i Q_i, \quad (\text{B.1, B.2})$$

g — fire load per unit area, MJ·m²

G_i — amount of fire load source material, kg;

Q_i — low heat value of individual material, MJ·kg⁻¹

According to SP 12.13130.2009 (§ 4.3) it is acceptable to use officially published data about fire hazardous properties of applied matters and materials, otherwise they should be defined by performing standardized testing or calculating operations with regard to existing environmental state parameters, such as temperature and pressure levels.

If any electrical equipment is planned to be installed it is required to define the fire-and explosion hazardous class of working premise according to the “Rules for the design and operation of electrical Installations” (in Russian “PUE”). PUE divides working premises into classes depending on the type of fire-and explosion hazard substances applied or stored there. This document defines П-I, П-II, П-IIa, and П-III classes for fire hazardous zones and B-I, B-Ia, B-Iб, B-Ir, B-II, B- Iia – for explosion hazard zones.

Also the following data should be provided to department which designs water supply and sewage systems for designing of the automated water fire-fighting systems:

- 1) Name of premise
- 2) Premise’s location or marking (according to agreed marking system applied at the room-by-room schedule), floor level
- 3) Premise’s overall dimensions (height, width, length), m

- 4) Total area of permanently opened apertures, m²
- 5) Maximum allowable over pressure level, MPa
- 6) Evacuation time, s
- 7) Indoor environment parameters
 - a) Temperature (t_{\max} and t_{\min}), C°
 - b) Pressure, kPa
 - c) Humidity, %
 - d) Type and key characteristics of ventilation system
- 8) Name of fire-stop damper and its closing time, s
- 9) Safety class of protected equipment
- 10) Fire hazard category of premise/working area
- 11) List of flammable and combustible substances and materials
- 12) Class of fire according to GOST 27331-87 "Fire engineering. Classification of fires" (depending on the type of the burning substances and materials)
- 13) Name of fire extinguishing agent
- 14) Floodable line level, m

If any raised floors or dropped ceilings that need to be protected are planned it should be mentioned in assignment together with providing of necessary drawings of these structures.

Supplemented graphical part should contain the drawings of electrical networks and pipelines, arrangement and installation drawing of protected equipment.

Explanatory note should contain additional requirements to the type and location of extinguishing and alarm systems, data concerning amount and working regime of operating staff, necessity of installation of additional firewater pumps and tanks.

2.2.5 Assignments for designing of water supply and sewage systems

Assignment defines the demands of water for the operating procedures, including demands for the system filling, feed water system and heat-water supply system functioning, performing the cleaning of premises and equipment.

It is also necessary to define volume of the overflow water, which for example comes through the pressure safety valves or emergency drain system.

Submitted data should consist of:

1. Data for designing of the processing waste water disposal system
 - Main characteristics of waste water discharges (name, chemistry, temperature, pollutant concentration)
 - Type of discharge mechanism (with or without get break)
 - Water flow rate (l/s, m³/h, m³/day)
 - Water consumption regime (permanent or periodical)
 - Pressure losses in the equipment (kg/cm²)
2. Data for designing of the utility and drinking water supply system for industrial consumers (Appendix 1)
3. Data for designing of the equipment cooling system (Appendix 2)

Graphical part should consist of equipment arrangement layout, installation drawings with locations and diameters of connection outlet and inlet pipes, balance scheme illustrating relation between water consumption and disposal processes, installation and arrangement drawings of processing pipelines.

2.2.6 Occupational safety requirements. Assessment of the emergency.

In the framework of safety assessment performing and planning of accident prevention measures process engineers should provide:

- description and scene of possible accidents
- prediction of accident consequences for people and surrounding structures
- list of accident preventive measures
- degrees of injury probability, potential health hazard, loss severity and accident risk (from 1 to 5 marking scale system)
- operation plan in case of emergency
- designation of persons responsible for planning and assuming of prevention measures

In case if processing equipment poses any potential hazard to human health special assignment to automation engineers can be given for placing of sensors which provides equipment deactivation or for designing of safety alarm systems.

3 STATE EXPERT REVIEW OF DESIGN DOCUMENTATION

Russian government created complex, time consuming but strictly operating system of control of construction process. Process of development and approving of all necessary project documentation can take up to several years. Its duration among other things depends on the following factors:

- The location of object (recent investigations show the 6 times difference in duration of receiving building permission in different regions of Russia)
- The amount of engineering and condition surveys needed to be complete
- Ability and experience of design and project companies to collect all the necessary initial data and approvals from local authorities in time (this factor significantly depends on the company's experience of operating in the concerned region of RF)
- Time spent upon adaptation, translation and formalization of required documents into Russian language for foreign companies;

As a result, it is possible to speed up the process by means of manipulating the above-mentioned factors, but the main problem is that the main findings of the project approval process include unnecessary bureaucratization, which leads to unnecessary costs and unpredictability. Unfortunately, in many cases the illegal methods are widely used in order to receive the construction permit in time. Among others severable breach of activity sequence, when the approval of the project is performed in parallel with construction process is used.

3.1 Common information about legislation base

Nowadays all the process of developing and approving of project documentation must be performed in accordance with the following main legislative documents:

- Town-Planning code of Russian Federation
- The Government Resolution dated 5 March, 2007 №. 145 “On the procedure for organization and performance of state expert review of project design documentation and results of engineering surveys”
- The Government Resolution dated 16 February, 2008 N° 87 “On the structure of sections of design documentation and requirements to their contents”

So in order to get a construction permit according to the Town-Planning Code it is necessary to develop the design documentation and to obtain a positive opinion of the state expertise.

According to these documents the process of state government review is performed either at the federal level or at the level of subjects of Russian Federation. The Federal State institution is called “The General State Expert Review Department of the State Committee for Construction, Housing and Utilities” (in Russian - Glavgosekspertiza) and this institution is responsible for expertise review in cases when construction, reconstruction or capital repair are performed:

- In the territories of more than one constituent entity of Russian Federation
- In the territories of Russian embassies, consulates and representative bodies located abroad
- In the exclusive economic zones of Russia, in the continental shelf zones
- for the security and civil defence facilities or objects information about which classified as state secret
- For the objects of cultural heritage of federal significance
- For the particularly dangerous, technically complex and unique objects mentioned in the art. 48.1 of the Town-Planning Code

In other cases expert review is performed by the government executive bodies of subjects of RF and authorized local government institutions, depending on the location of planned construction. Competence and enforcement powers of responsible for performing of the expertise review state institutions, the order of expert review and engineering survey results implementation, main requirements to the completeness and content of documentation etc. are defined by the Government Resolution N° 145.

Many rules are set by the local instances. For example, differences are detected even between methods of documentation review in the State Construction Supervision and Expertise Department of Saint Petersburg and in the same organization in the Leningrad region. Definitely, all the main standards and regulation documents are the same, however the procedure is more complicated because only the authorized representative of customer has a right to visit the expert, while designer have to carry on an official correspondence with expertise department in cases of misunderstanding situations.

According to Resolution No87 procedure of expertise review differs due to the type of capital construction object, which are divided onto 3 groups:

- industrial objects
- non-industrial objects
- linear objects

As far as the activities of ECO Environment Ltd. Oy refers to the industrial objects and this company is interested in operating in the closest to Finland regions of Russia the main emphasize is made on the specifics of procedures, that need to be done during processes of reconstruction and technical re-equipping of existing industrial objects in accordance with legislations of Saint-Petersburg and Leningrad region.

3.2 Content, appearance and scope of design documentation

The project design stage involves preparation of several volumes of design information for its submission to the local expertise. This includes the

preparation of architectural plans, sections and elevations, the definition of the fire protection strategy and parameters of technological processes, sizing of all principal structural elements, finalization of technical conditions for utility supplies and the preparation of the principal schematics for the engineering systems. Customer is responsible for submission of the project documentation to the state supervision bodies and architectural agencies, while the defence of the design conception and solutions is performed by the design organization with the customer's participation.

Design task and initial data required for the beginning of the designing operations and performing the engineering surveys should be given to designer by customer. However the variant, when the designer is responsible for collecting of initial data is possible. In this case it should be approved by the customer and the cost of this service is a subject of a contract between customer and design organization.

In case if developing of design documentation is made under the contract agreement the following documents provide basis for its development (Town-Planning Code ,art.48,§6):

- Report documentation concerning the results of engineering surveys
- Approved and registered Town-planning solution plan of a land plot
- Technical conditions (in case if functioning of the capital construction object is impossible without connection to the engineering networks)

In fact for beginning of design process the following additional data is required:

- Design assignment for the capital construction object approved by Customer and agreed upon the Chief Civil Defense and Emergency Department GU GO ChS
- Order of the Governor, Administration decree on permission for implementation of design and survey works
- Licensing letter of the Committee on Architecture and Town Planning
- Documents of entitlement in case of reconstruction or capital repairs of capital construction object (rental contract, certificate of ownership)

- Measurement drawings (in case of reconstruction)
- Technical conclusion about condition of load-bearing structures (in case of reconstruction)
- Topographic survey with underground networks marked (1:500)

It should be mentioned, that this list is approximate. More specified check-list is made pursuant to existing legislation and depends on the functional purposes of the building, location, geological, natural and climatic conditions and specific regulations of each subject of Russian Federation. For example in case of capital repair and modernization of existing networks in order to identify the distressed engineering networks the check-off lists of existing defects should be composed and some preliminary estimations of energy and other demands of the object should be done (special assignment from the customer is needed).

Moreover, represented scope of documents can be just a small part of all the package of initial permissive documentation (IPD), which is needed for legal implementation of all designing and construction works .It is collected during pre-design stage of project implementation and consists of different kinds of administrative documents , permissions, technical conditions, results of engineering surveys, approvals and other documentation received from authorized government bodies and organizations, specialized in the development and approving of design documentation and construction. IPD also includes requirements and recommendations obtained from the approval organizations during receiving of permission for design documentation development.

Basis for development of IPD is an order from local authorities, which is given on the grounds of customer's application processing. IPD is given by designated institution or special government authority to the applicant by paying the flat rate. The amount and names of design documentation sections are defined by the Town Planning Code (Art. 48, § 12):

- 1) Explanatory note
- 2) Layout of the land plot

- 3) Architectural concept
- 4) Structural and spacial layout decisions
- 5) Information about engineering equipment, engineering networks, list of engineering and technical measures, content of process solutions
 - a. Electricity supply system
 - b. Water supply system
 - c. Water disposal system
 - d. Heating, ventilation and air conditioning, heat supply network
 - e. Communication networks
 - f. Gas supply system
 - g. Technological process solutions
- 6) Project of construction organization
- 7) Project of construction organization during process of demolition or disassembling
- 8) List of Environmental Protection Measures
- 9) Fire safety measures
- 10) Provisions of Support the Access for Disabled persons
- 11) Capital construction project estimating
 - a) Other documentation in the cases provided by the federal laws (Industrial and fire safety declarations, civil defence measures, etc.)

Detailed information concerning content and structure of above-mentioned sections is provided by the Government Resolution № 87. Content of sections also should be specified by the design assignment if necessary. Each section of project can consists of several parts – “books” and each book consists of

- textual part including main information about the object of capital construction, description and explanation of design solutions, references to the regulative and/or technical documents and calculation results as a substantiation of design decisions and
- graphical part, including drawings, schemes, diagrams etc.

The development of additional sections can be realized if it is reasonable and determined by technical regulations, applicable design codes, national

standards and other regulations, defined by the federal authorities. If the financing of project is realized without using of governmental budgetary funds the necessity and volume of development of items No 5, 6, 9 and 11 is set by customer and should be specified in the technical design assignment. Other parts of documentation must be realized in a full measure.

Among other things this resolution enacts design process, which is based on separated development of design and detailed working documentation. It doesn't contain any provisions for the stage-by stage system of project development, which was used before and included stages of project technical and economic substantiation or feasibility study for object investment. Also the previous document submitted to the state expertise "Working project" became delegitimized. This means that level of detalization of design documentation should be enough for the project solutions' assessment, but not excessive. More detailed information should be provided in the working documentation which is developed to realize during construction process all the architectural and technological design decisions and consists of textual documents, working drawings and bills of materials. Volume, content and structure of detailed working documentation should be defined by customer and mentioned in design assignment for capital investment object. Only design, but not working documentation must be submitted for the expertise.

Design documentation can be developed either for the entire object of construction/reconstruction or by stages. The necessity of the "stage by stage" development is set up by customer and should be specified in the design assignment. (Town Planning Code Art 48, §12.1). Moreover, the right for documentation expert review and development on a stage basis should be explanted by the special calculations, which proves the technological capability of design solutions' realization .Stage-by-stage preparation of design documentation means that constructed during single stage object could be commissioned into operation and exploited independently from construction of other parts of object of capital construction.

Appearance of design documentation is regulated by the Russian system of design documentation for construction (SPDS) and unified design documentation system (ESKD). Basic documents are GOST R 21 1101-2009 “Main requirements for design and working documentation” and GOST 21.501-93 (2002) “Rules for execution of architectural and construction working drawings”. Abbreviation GOST R means that this is a national standard, developed by the Federal agency for Technical Regulation and Metrology (Rosstandart).

3.3 Engineering surveys

Engineering surveys should be performed before every construction process in order to take into account during designing process surrounding natural and anthropogenic conditions of planned construction site. Pursuant to the Art. 47 of the Town-planning Code preparation and implementation of project documentation without performing of the relevant engineering surveys is not allowed.

Engineering surveys should be implemented by specialized company which acts as a member of Self-Regulatory Construction Organization. During the pre-design stage employed organization should be provided by the technical assignment for implementation of environmental, engineering geological and engineering technical investigations (the study of land geologic structure: soil structure and properties, the state of load carrying structure, foundation examination, etc.). Meanwhile no requirements to the content, volume, procedure and technology of survey execution can be set by this assignment.

The results of engineering surveys are valid within 2-3 years before the design process beginning and they need to be approved by the state expertise separately, before the expertise of project documentation, or together with the project documentation. In case of separate examination 45 day period is set for the reviewing procedure (Resolution No 145, art. 29). During examination their compliance with technical regulations is checked.

The list of main and specific types of engineering surveys is determined by the Government Resolution N° 20 dated 19 of January 2006 "On Engineering Surveys for the Preparation of Project Documentation for Construction and Reconstruction" and includes the following surveys:

- 1) Main types of engineering surveys
 - a) topographical
 - b) geological
 - c) hydrometeorological
 - d) environmental
 - e) geotechnical
- 2) Special types of engineering surveys
 - a) geotechnical investigations
 - b) condition survey of the foundation soil layers of buildings and facilities
 - c) exploration and prospecting of the underground waters for the water-supply purposes
 - d) local monitoring of the environment components
 - e) prospecting of the local soils for the purposes of construction
 - f) local surveys of the polluted soils and waters

Necessity of performing of certain types of above-noted surveys, their structure, volume and content are established by the engineering survey program, developed by the survey executer on the base of technical assignment for survey implementation and initial data provided by customer. Program of surveys should be developed before signing contract for works performing between customer and executing company. Contract agreement also should be supplemented with the work schedule of planned surveys and their estimated cost.

Resolution No 20 establishes rules for performing of engineering surveys for study of natural conditions and technical factors and according to it the executive bodies of the subjects of the Russian Federation are authorized to develop and approve upon agreement with the Ministry of Regional Development of the Russian Federation their own orders for implementation of

engineering surveys in the territory of these subjects. This means that once again everything depends mainly on the object's location.

Issuing of warrants, which open a green signal for survey implementation in St.Petersburg is performed by the State Construction Supervision and Expertise Department .

3.4 Procedure description of state expert review

The main purpose of state expertise review is to check the compliance of design documentation with technical regulations, including requirements of legal and normative acts concerning labor, ecology, protection of cultural heritage , requirements to the sanitation-and-epidemiological, fire, nuclear, industrial and health safety, requirements of civil defence governmental authorities as well as compliance with results of engineering survey results. It is an obligatory procedure performed before approval of documentation by customer and receiving construction permit. Exceptions to this rule are made only in cases of some low-rise and small-area buildings or when no construction permit is required, or in cases of standardized unit construction without making alterations influencing on the object's safety and reliability.

For projects developed within the territory of St. Petersburg all the stages and their duration are set by the "Regulations for performance of state expert review of design documentation and engineering survey results in St. Petersburg" (Table 6). This information is also applicable for projects developed in the territory of Leningrad region. For non-residential objects this document stipulates the 90day period of design documentation review. Possibility of reduction of set terms can be covered by the agreement for the expertise implementation or by special decision of government authorities of subjects of Russian Federation.

Table 6. Stages of the state expert examination procedure

<p>Table 6 Stages of the state expert examination procedure1 - 3 days (10 days – for complicated objects) art.21 of Resolution No145</p>	<p>Acceptance of design documentation and engineering survey results, assignment of identification number. The completeness of documentation is checked.</p> <p>Application request form which must be sent for documentation acceptance is represented in the Appendix 4 of the thesis. Together with filled application form and design documentation package applicant should submit (Resolution No145, §13):</p> <ul style="list-style-type: none"> • copy of design assignment for capital construction object • engineering survey results and copy of assignment for engineering survey implementation • positive conclusion of state ecological expertise in cases when construction process is performed in the exclusive economic zones, at the continental shelf or in the internal sea waters of Russian Federation. • documents confirming applicant’s empowerments to act on behalf of customer or building contractor (in cases when applicant is represented by any other organization) <p>For evaluating of cost for performing of the expertise review applicant also should provide estimate of design costs (for both – design and detailed working documentation) and engineering survey costs</p> <p>Result: Refusal to accept documentation for the further examination or signing of contract for state expert review performing. Project review starts after receiving the confirmation of payment made by applicant.</p>
---	---

4 - 29 days	<p>Expertise review, detection of mistakes</p> <p>In case if necessity for submission of additional engineering surveys, calculations or even redesigning of whole sections is defined by the experts, written request for submission of lacking documentation should be sent to the customer.</p> <p>New rules entitle the possibility to make changes in the documentation during the expertise proceeding, before the final conclusion is given. If the volume of submitted documentation is insufficient for implementation of the expert review the notification about returning of design documentation and refusal in the further review should be sent to the customer.</p> <p>Transmission of remarks to the department responsible for the issuance of final experts' reports.</p>
30 - 40 days	<p>Preparation and execution of the preliminary conclusion by the leading expert ("Remarks")</p> <p>Approval of the "Remarks" by the department chiefs</p> <p>Approval of the "Remarks" by the deputy chief of the St.Petersburg "State expertise center"</p> <p>All the corrections are placed into one file (2 copies) and one copy is given to the customer (applicant). Customer applies the necessary corrections and returns documentation to the experts</p>
41 – 79 days	Remission of the corrections
80 - 90 days	<p>Preparation and execution of final expert's conclusion</p> <p>Uncorrected remarks of experts are used as a basis for the negative conclusion, which is also given to the customer</p> <p>Case closure. The documentation is placed in the archives</p>

Refusal to accept for consideration design documentation or engineering survey results can be reasoned by (art. 49, §8):

- 1) Absence of required sections of design documentation or supplemented documents
- 2) Design documentation development or implementation of engineering survey results by the party, which is not a member of Self Regulating Organization (art. 48, §4,5 and art. 47, §2, 3). This is an obligatory condition in case if performed activities influence on the safety of constructed object.
- 3) Absence of engineering survey results or earlier received positive conclusion in case of their separate examination, or nonconformance of results with requirements to the content and appearance

3.5 Re-examination procedure

Negative conclusion of the state expertise can be contested judicially by the object builder or customer. Otherwise after making necessary alterations design documentation should be again submitted for examination.

The whole procedure of expert re-examination is the same as for initial expert review. It is performed by the same experts and only the newly submitted or corrected documentation is examined. The rest is just checked for compatibility with the corrected documentation.

No limit s is set for the number of state expert re-examination procedure, which is performed in the following cases (Resolution N145, :

- In case of positive conclusion additional review and correction of design documentation and engineering survey results is required if some changes of the project were made, while earlier the positive conclusion of state expertise had been received
- completion (redesigning) or submission of new sections was made according to the corrections of the previous negative expert conclusion

In case when negative conclusion is received customer should settle the new contract for documentation re-examination and make an additional payment. For additional expert review the 30% payment of the first expert examination is made and 80 days are given for correction implementation. For remarks of experts, which is done within the procedure of expert review from 20 to 40 days is given to comply with remarks.

Corrections should be done in a form of description of performed alterations structured as a separate book with continuous numbering of pages. It must be supplemented with summary comment resolution table containing references to the necessary book page numbers.

3.6 Cost of expert review implementation

Payment for expert review implementation should be made by the applicant party. It can be either customer or design organization depending on the design contract. Total amount of payment in case of non-residential objects is calculated with the following formula (Resolution No 145, art.56):

$$A = C_{pd} \times P \times K_i + C_{es} \times P \times K_i$$

C_{pd} - cost of design documentation development calculated at 2001 values according to the regulative documents applicable to the procedures of cost estimation and price formation set by the Ministry of Regional Development of RF (in rubles)

C_{es} - cost of engineering surveys implementation calculated at 2001 values according to the regulative documents applicable to the procedures of cost estimation and price formation set by the Ministry of Regional Development of RF(in rubles)

P – percentage of integrated cost for implementation of design and engineering survey works results of which are submitted to the state expert review

K_i – coefficient, which reflects the inflation development in comparison with the situation on the 1st of January, 2001. Calculated as a product of consumer price indexes for each year beginning from the 2001 year(inclusively) on out to the year preceding the current year (in which the determination of cost for the expert review is performed).These indexes are published by the Federal State Statistics Service

Table 7. Percentage-based cost relationship for expert-review cost calculating (Resolution No 145, Appendix)

Integrated cost ($C_{pd}+C_{es}$) (measured in 2001 mln rubles)	Percentage of integrated cost (measured in 2001 mln rubles)
0 - 0,15	33,75
>0,15	29,25
>0,25	27,3
>0,5	20,22
>0,75	16,65
>1	12,69
>1,5	11,88
>3	10,98
>4	8,77
> 6	7,07
>160	6,15
>12	4,76
>24	4,13
>18	3,52
>36	3,06
>30	2,62
>45	2,33
>52,5	2,01
>70	1,68
>60	1,56
>80	1,22
>100	1,04
>120	0,9
>140	0,8
>160	0,73
>180	0,66
>200	0,61
>220	0,58

In other words amount of payment for the expertise review is evaluated as a percentage of inputs for design and survey works implementation and nowadays this value ranges within 7-8%. That is way the completeness and

actuality of submitted cost estimate results for design and survey works is checked by the experts in order to prevent artificial lowering of price levels.

4 CONCLUSIONS

Unfortunately, all the attempts aimed to find any up-to-date documents describing content and structure of design assignment or sequence of operations during its submission to related departments had not met with success.

It was found, that certain guidelines exist only in experienced design institutions with developed system of local standards. As far as creating of this system is quite expensive procedure, which takes a bit of organization and management work, no provisions are made for affording open access to this internal information.

That is why in most cases designing is performed under conditions of initial data incompleteness. This in turn can lead to situations when it is necessary to take into account already adopted design solutions, without any coordination with other project parts. For example, when designing of the networks and equipment arrangement should be performed in the already constructed building.

Moreover strictly defined requirements to the preparation procedure, form and content of provided data are unappropriated in the context of mobility retention of design process. The main reason is that lots of interconnected design solutions can be made only during the face-to-face immediate communication between project participants.

However the approximate algorithm scheme of assignment submission procedure was created during thesis writing (Chart 2) and description of basic provided data was made according to the already completed projects.

The analysis of existing situation connected with performing of the state expert review of design documentation shows that construction industry is one the most regulated industrial sectors in Russia nowadays. Moreover during last few years the list of main legislation documents changes significantly and thereafter the whole process of examination, performed by the state expertise nowadays is still a kind of novelty even for sophisticated designers. However from the most of experts' point of view all the stages of this process are logical and rational. All the main difficulties are connected first of all with complexity of the process in whole, lack of well-defined rules about process performing, failure to meet a date in approval organizations.

As the background analysis shows the main difficulties during design documentation examination are connected with the following aspects:

1. Presence of all the necessary project parts, permissions, conclusions and approvals, according to rules set by the government either at the federal or at the local level
2. Complying with the remarks of the state expertise review organizations under the tight deadlines
3. Necessity to meet the "personal" requirements of some experts. Sometimes it is next to impossible to prove designer's point of view during consultations with particular construction experts or it can take too much time. This can be caused for example by the variant readings of existing laws and standards because of their contradictoriness.

So in order to prevent the disputable situations it is reasonable to engage the dedicated sub-specialists, which develop specific project parts over a long-time period and they are familiar with the main requirements and preferences of the particular experts.

CHARTS

Chart 1. Schema of the interacting process between main departments of design organization

Chart 2 Schema of the design assignments submission process

TABLES

Table 1 Organization of the design assignment preparation procedure

Table 2 Equipment load data

Table 3 Initial requirements to illumination measured on the floor level

Table 4 Coefficient of proportionality for evaluating of components of equipment dynamic forces

Table 5 Equipment fire load data

Table 6 Stages of the state expert examination procedure

Table 7 Percentage-based cost relationship for expert-review cost calculating

REFERENCES

GOST 12.1.005-88, 1988. Occupational safety standards system. General sanitary requirements for working zone air

GOST 21.110-95, 1995. Rules of developing specifications for equipment, products and materials

GOST R 21 1101-2009, 2009. System of design documentation for construction. Main requirements for design and working documentation

Government Resolution N° 20, 2006. On engineering surveys for preparation of project documentation for construction and reconstruction.

Government Resolution №87, 2008. On the structure of sections of design documentation and requirements to their composition. Edition from 25 May 2011

Government Resolution №145, 2007. On the procedure of organization and performance of state expert review of project design documentation and engineering surveys. Edition from 7 November 2008

Grinberg , Ya. 1970. Designing of chemical production facilities. Development of the assembly and process design documentation.

MR 21.03-99, 1999. Guidelines for preparation of initial requirements on the development of detailed engineering documentation for individually tailored equipment.

NPB 105-03, 2003. Determination of categories of rooms, buildings and external installations on explosion and fire hazard.

Order No 23-p, 2009. Regulations for performance of state expert review of design documentation and engineering survey results in St. Petersburg

RM 25-251-90, 1990. Design assignments submitted to the general designer for realization of related project parts in case of automation project implementation. Part 3

RMD 11-08-2009, 2009. Guidelines for design preparations of capital construction objects in St. Petersburg

SNiP 2.02.05-87, 1987. Foundations of machines with dynamic loads.

SNiP 11-01-95, 1995. Instructions. Procedure of development, endorsement, approval and composition of design documentation for construction of plants, buildings and structures. Cancelled in 2008.

SP 52.13330.2011, 2011. Natural and artificial lightening.

SP 12.13130.2009. Determination of categories of rooms, buildings and external installations on explosion and fire hazard.

SanPiN 2.6.1.24-03, 2003. Sanitary rules for designing and exploitation of nuclear power stations.

Town Planning Code, 2004. Edition from 25 March 2011