

## FORM MINORS AND FORCE MAJEURE

Ensuring technological sustainability and preserving the investment value of unfinished nuclear power plant construction projects in the context of global instability .

### Introduction: Nuclear Energy in a Zone of Uncertainty

#### Limitations of the study

***Important note:** This work focuses exclusively on the design and construction phases of nuclear power plants (unfinished construction projects). Issues of ensuring the safety, operation, and resilience of existing power units under conflict and sanctions require separate, specific analysis and will be addressed in our next work.*

The current stage of global nuclear energy development is characterized by an unprecedented combination of ambitious plans to build hundreds of new power units and, simultaneously, an extremely high probability of local and global conflicts. We are at a point where technological advancement collides with the reality of trade wars, severe sanctions, and geopolitical turbulence.

Historically, nuclear power plant projects were designed for decades of stable cooperation, but the current situation requires a fundamental revision of approaches to project lifecycle management, particularly during the construction phase. In our work "**Form Minor and Force Majeure**," we identify two key risk poles:

- **Form minors** are technical, logistical, and legal barriers that arise in peacetime, such as bans on the supply of individual units of equipment, requiring rapid adaptation of the project and the search for innovative engineering solutions.
- "**Force majeure**" is a critical circumstance (pandemics, military action, political ruptures) that could lead to the spontaneous and uncontrolled closure of construction sites.

Experience shows that underestimating these risks leads to catastrophic consequences: unprotected structures can become unsafe or irreparably damaged under environmental influences. Without a well-developed set of compensatory measures, restarting construction after the crisis may become physically and economically impossible.

Removing a construction site from the active construction phase requires significant intellectual and material investment, balanced planning, a dedicated regulatory framework, interaction with internationally recognized organizations and national regulatory bodies, discussions with trade unions during the release of labor, careful organization, coordination, and control of work, the creation of specialized infrastructure, the development of innovative engineering solutions, and highly qualified personnel.

**The purpose of this paper** is to systematize accumulated experience (including the Angra-3 and Belene NPP cases) and propose a methodology for preserving the investment value of unfinished construction projects. We strive to create an algorithm that will transform a forced shutdown from a "financial catastrophe" into a "managed pause," ensuring the preservation of structures, equipment, and, importantly, the reputation of Rosatom State Corporation in the global market.

The choice of Rosatom State Corporation projects as the baseline for the study stems from the corporation's leading position in the global market: with the largest portfolio of international orders at various stages of implementation, Rosatom faces the most comprehensive range of challenges—from sanctions restrictions on international cooperation to the need to adapt projects to various national regulatory requirements.

## Section I. "Form Minors": Technical and Logistic Adaptation

This section is devoted to situations that do not stop construction completely, but create "interference" that require changes to design solutions (Change Management) under external pressure.

### Chapter 1. Sanctioned replacement of equipment and modification of the Project

In peacetime, trade wars and sanctions lead to targeted bans on the supply of critical equipment (pumps, electronics, valves, specialized sensors). This is a classic "form minor" situation that can escalate into a catastrophe without a well-functioning adaptation mechanism.

#### 1.1. Algorithm for identifying supply risks

- **Specification audit:** Continuous monitoring of "red zones" - equipment manufactured in countries prone to trade restrictions.
- **Assessing interchangeability:** Dividing equipment into standard (replaceable without significant redesign) and unique (requiring changes to the system architecture).

#### 1.2. The Problem of "Harmonization of Standards"

When replacing European or American equipment with similar equipment from friendly countries or domestically produced ones, a conflict of regulatory frameworks arises.

- **Differences in tolerances and materials:** The need to recalculate strength characteristics and hydraulic conditions when using alternative alloys or sizes.
- **Adaptation of the automated process control system:** Integration of new nodes into the existing digital environment of the station requires "innovative engineering solutions" and highly qualified personnel.

#### 1.3. Legal support for "minor forms"

Any change to the Project must be legalized at the international level to avoid claims from the customer or national regulator in the future.

- **Documentation of reasons:** Clearly document that the change was caused by an external prohibition, and not by the general contractor's desire to save money.
- **Regulatory Approval:** Use of methods that ensure the safety of the facility for the public and the environment, even if it deviates from the original design.

When revising a portion of a project due to equipment replacement, we rely on a fundamental principle: any deviation from the original design decisions must be justified and legalized.

The main regulatory document in Russian practice (which also serves as the basis for Rosatom's international projects) is **GOST R 21.101-2020 "System of design documentation for construction. Basic requirements for design and working documentation . "**

According to this and related industry documents, the replacement process is as follows:

## 1. Legal and regulatory framework for making changes

- **Changes to design documentation** : Any change of equipment that affects process processes, layout or loads requires the issuance of a “Permission to Make Changes”.
- **Compliance with Federal Law 190 (Urban Planning Code of the Russian Federation)** : If equipment replacement results in a change in the parameters of a capital construction project (capacity, safety, reliability), the design documentation may be subject to re-examination or confirmation by the chief project engineer (CPE) that the changes do not affect safety.
- **NP-001-15 (OPB NPP)** : In the nuclear industry, the replacement of critical equipment must comply with the “General Provisions for Ensuring the Safety of Nuclear Power Plants”, which requires a revision of the safety case (SCC).

## 2. Compensatory mechanism of the "Project maneuver"

To ensure that equipment replacement does not result in construction being stopped, the following regulatory procedure is applied:

- **Equivalence assessment** : Conducting a comparative analysis of technical characteristics (weight, dimensions, energy consumption, connection dimensions).
- **Reflection in the “executive documentation”** : If the replacement is recognized as a “form-minor” (insignificant change), it is recorded in the working documentation with the note “Applied instead of...”
- **Integration into the automated process control system** : Mandatory verification of the compatibility of data transmission protocols of new equipment with the general plant control system.

## 3. International aspect (FIDIC and national standards)

In international projects, such as Akkuyu, equipment replacement is also regulated by contract terms (e.g. **FIDIC Silver Book**):

- **Variation Order** : A formal document initiating a substitution procedure due to undeliverability.
- **Compliance with Local Law** : The need to prove to the local regulator (e.g. NDK in Turkey) that the new equipment complies with the national safety standards of the host country.

**Summary** : Replacing even one pump or sensor is a **Change Management procedure** regulated by GOST R 21.101 and international quality standards of the ISO 9001 series.

### 1. 4. *The most vulnerable groups of equipment sensitive to replacement*

For our work "**Form Minors and Force Majeure**" to be of practical value, it is necessary to specify the equipment groups that are most vulnerable to impact from sanctions and trade wars. This will allow technical services to prepare "Project Maneuvers" in advance.

In nuclear construction, the most vulnerable positions are those traditionally dominated by a narrow circle of Western manufacturers or those requiring unique, high-tech components.

### Group 1. Launch complex equipment (Long Lead Items)

This equipment has a long manufacturing cycle, the replacement of which at the delivery stage critically delays the launch date.

- **Main circulation pumps (MCP):** Vulnerable to bearings and mechanical seals if they are supplied from EU or US countries.
- **Turbogenerator set:** Special attention to turbine blades and excitation systems.
- **Control and Protection Systems (CPS) drives:** High-precision mechanisms requiring specific alloys and electronics.

### Group 2. Automated control systems (ACS TP)

The most sensitive part of the “digital heart” of a nuclear power plant, where “form minor” may require a complete rework of the software code and architecture.

- **Microprocessor technology and controllers:** Direct dependence on the element base (chips) produced by world leaders.
- **Software:** Risks of blocked licenses, updates and real-time technical support.
- **Sensors and instrumentation (control and measuring devices):** Specialized pressure, temperature and radiation monitoring sensors with international certification.

### Group 3. Auxiliary technological equipment

Here the replacement seems simpler, but the mass of positions creates a “falling domino” effect.

- **Special fittings and valves:** High safety classes require specific tests and certificates, which may be revoked due to sanctions.
- **Ventilation and air conditioning systems:** It would seem like a simple position, but the containment area requires unique filters and drives.
- **Electrical equipment:** High-voltage transformers and switchgear.

### Group 4. Temporary construction infrastructure

Equipment necessary for the construction process itself, without which construction physically comes to a standstill.

- **Heavy Cranes:** Rental and maintenance of super-heavy cranes for reactor vessel assembly often rely on international companies.
- **Concrete plants and pumps:** Dependence on imported spare parts and chemicals (additives) for concrete, which is critical to ensuring the strength of structures.

### Protection mechanism for these groups:

For each of the specified positions, our methodology provides for:

1. **Technical justification for the possibility of replacement** to prevent the risk of project failure as an investment reserve.
2. **Developing a conservation strategy** specifically for this type of equipment in the event of contract suspensions due to Force Majeure.

3. **Assessment of the environmental impact** on equipment in case of its long-term storage in open areas.

### **1.5 . Logistics shoulder and "warehouse cushion"**

- **Lead Order:** For Long Lead Items, it is advisable to create a lead order before there is a real risk of a ban.
- **Creation of temporary infrastructure:** Expanding storage space at the NPP site itself to store equipment "in reserve" in case of sudden border closures.

### **1. 6 . Chapter Summary:**

Replacing a single piece of equipment isn't just a logistical task; it's a complete overhaul of a portion of the project. The key goal here is to prevent a minor issue from becoming the reason for the suspension of the entire critical construction path.

## **Chapter 2. The Impact of Constraints on the Project and the Algorithm for Documentary Changes to the Project**

**When the delivery of critical equipment (from the categories described in Chapter 1) becomes unavailable due to sanctions or trade wars, the project moves from the planned construction phase to the crisis change management phase .**

### **2.1. Consequences of constraints for the project**

Supply constraints create a chain of negative factors that could lead to a "domino fall" scenario :

- **Technological gap:** Inability to complete the installation of launch complex systems due to the absence of individual but key components (sensors, drives, fittings) .
- **Safety hazard:** Capital construction projects, remaining unfinished and not equipped with equipment, are exposed to aggressive environmental influences, which may lead to their emergency condition .
- **Economic damage:** Delays in deliveries lead to the suspension of contracts, loss of economic ties and the need to pay compensation .
- **Reputational risks:** Uncontrolled delays in meeting deadlines cause colossal damage to the image of Rosatom State Corporation as a reliable international supplier .

### **2.2. Algorithm for documenting changes to the Project (Change Management)**

To legalize changes and maintain a secure legal position, it is necessary to follow strict regulations for the transformation of project documentation, separating the rights and obligations of the parties for each type of event:

#### **Step 1. Recording the event (Evidence base)**

1. **For Force Majeure (Global Level) :**
  - It is necessary to document that the circumstance is external, insurmountable and makes the fulfillment of obligations impossible under current conditions .
  - **Proof :** CCI (Chamber of Commerce and Industry) Certificate, government regulations, official notifications of sanctions .

**2. For "Form Minor" (Technical Level) :**

- Documented as a "technical obstacle" caused by an external constraint (e.g., a specific plant's failure to supply) that requires adaptation but not termination of the project .
- **Proof** : Official refusal from the supplier, market analysis protocol confirming the absence of an identical analogue .

**Step 2. Regulation of the rights of the "Minor" and "Major"**

To ensure the sustainability of the project, we are introducing a division of rights among participants:

<b>Event category</b>	<b>Rights and obligations of participants (Regulations)</b>	<b>Normative justification</b>
<b>Form minor</b> (Technical correction)	<b>The General Designer's Right</b> : Prompt change of specifications without revising the entire Contract . <b>The Customer's Responsibility</b> : Agree on an equivalent replacement on an expedited basis (Fast-track) .	<b>GOST R 21.101-2020</b> (Permission to make changes) , <b>ISO 9001</b> (Change Management) .
<b>Force Majeure</b> (Global Stop)	<b>The General Contractor's right</b> : Suspension of work without penalties and the right to compensation for mothballing costs . <b>The responsibility of both parties</b> : Joint development of a "suspended animation" strategy .	<b>FIDIC Silver Book</b> (Variation Order/Force Majeure) .

**Addition to the methodology:**

To legalize these processes, the project proposes to introduce a **“Unified Regulation for Managing Project Deviations .”**

This document must:

1. **Grant "minor right"** : Allow site engineers to perform equipment replacement through an "Equivalence Assessment" if this does not change the nuclear safety of the facility .
2. **Secure the “right of major”** : Establish that in the event of force majeure, intellectual property (IP) rights and project information are immediately transferred to the “digital preservation” mode under the protection of the successor .

**Step 3. Development of a Technical Proposal (TP)**

- A justification for replacing equipment is formed based on the principles of ensuring the strength, stability and safety of the facility .

- “Compensatory measures” are being developed to allow the integration of alternative equipment without reducing the quality characteristics of the nuclear power plant .

#### **Step 4. Amendments to design and working documentation**

- **Adjusting contract strategies:** Revising contract structures to include new suppliers and changing acceptance conditions .
- **Specification update:** In accordance with **GOST R 21.101-2020** , a "Permission to Amend" is issued. The explanatory note provides a rationale for the need to preserve or replace individual components to ensure the effective use of unfinished construction as an investment reserve .
- **Adaptation to the legal framework:** Changes must comply with both the national legislation of the host country (for example, the Republic of Turkey) and the Russian regulatory framework .

#### **Step 5. Coordination with the regulator and stakeholders**

- Preparation of a reasoned decision on the conservation of an object or part of it during the search for and replacement of equipment .
- Conducting video conferences and technical meetings to transform proposals into approved contract specifications .

### **2.3. Chapter Summary**

Documentary modification of the "Project" under restrictions is not simply the replacement of a single sheet of paper in a folder, but a comprehensive protection of the rights of the developer and investor through a mechanism for legalizing new technical solutions within the national legal framework .

### **Chapter 3. Personnel Shortage: Risks and Compensation**

Project suspension or sanctions pressure inevitably hit the most valuable asset – the staff.

#### ***Risks of contractor departure:***

The departure of national and Russian companies and customers may occur due to precautionary measures, uncertainty about the end of the crisis, or changes in local legislation.

#### ***Loss of qualification:***

Withdrawal of a construction site from the active phase requires highly qualified personnel, and their loss makes subsequent resumption of construction impossible.

#### ***Compensation methods:***

- **Renegotiating Employment Contracts** : Contractual strategies must be tailored to each circumstance, including adjustments related to the termination of existing contracts and the establishment of new ones to ensure site security.
- **Trade Union Liaison** : When laying off workers, discussions with trade unions and careful organisation of the process are required.

- **Use of expert potential** : Involvement of international experts with a different technological culture to develop methods for assessing the condition of objects.

## Chapter 4. Legal risks of Rosatom State Corporation in the situation of forced suspension of construction

Rosatom State Corporation's legal risks in the event of a forced construction suspension are not simply the threat of fines, but rather the issue of preserving the corporation's international legal personality and assets.

Based on the specifics of the nuclear industry, let's delve into the legal framework:

### 1. Risk of "Unproven Force Majeure"

The most critical risk is the inability to legally qualify sanctions or conflict as a force majeure event in a particular jurisdiction.

- **Burden of proof** : A party must not simply refer to the fact of sanctions, but must prove that the event specifically prevented performance (for example, a direct ban on the export of a specific HS code).
- **"Reasonable steps"** : A legal position is considered protected only if it is proven that all measures have been taken to mitigate the consequences (search for alternative supply routes, conservation).

### 2. Risk of loss of developer and investor rights

In case of uncontrolled "spontaneous" closure of the site:

- **Loss of control over the territory** : In the event of a suspension for political reasons, there is a risk of nationalization of unfinished construction or transfer of the site to third parties without compensation for Rosatom's costs.
- **Legal vacuum of conservation** : The absence of clear regulations for a "safe pause" in the national legislation of the host country may lead to the regulator deeming the facility unsafe and revoking the construction license.

### 3. Liability under employment and subcontracting agreements

- **Mass lawsuits** : Work stoppages necessitate adjustments to contracting strategies and the termination or freezing of hundreds of contracts (including employment contracts). Without a dedicated legal framework, this threatens colossal financial losses in local courts.
- **Withdrawal of national partners** : Invoking force majeure by local customers may lead to unilateral termination of funding.

### 4. Risks to intellectual property and information

- **Data loss** : During a chaotic shutdown, there is a high risk of "inevitable loss of some information about the object" (executive documentation, monitoring data).
- **Technology transfer** : Risk of unauthorized access to Russian technologies on abandoned or "frozen" sites by competitors or unfriendly countries.

### ***Summary of compensatory measures:***

To mitigate these risks it is necessary:

1. **Legalize conservation methods** at the international level by making them part of intergovernmental agreements.
2. **Formulate proposals for amendments to the legal acts** of the countries of presence to protect the rights of investors during the “pause” period.
3. **Create a “digital preservation” regulation** to protect all design and technical information.

## **Section II. Controlled Shutdown Methodology: Scenarios and Procedures**

Taking a nuclear power plant construction site out of the active phase requires significant intellectual and material investment, a specialized regulatory framework, and innovative engineering solutions . To avoid a "falling domino"—when peak economic losses and a recession render the project unviable—construction termination or suspension strategies must be developed in advance .

### **Chapter 5. Scenario Planning for "Safe Pause"**

Our methodology is based on four scenarios, which depend on the severity of the crisis, the duration of restrictions on the movement of goods and citizens, and the likelihood of disruption to production chains .

#### ***1. Soft Scenario (Local Failure)***

- **Characteristic** : Short-term delays in the delivery of individual equipment or temporary logistical difficulties.
- **Actions** : Implementation of the “Project Maneuver” mechanism (Chapter 1), use of warehouse reserves on site.
- **Objective** : Maintain the critical path of the schedule without stopping the main work.

#### ***2. Moderate Scenario (Imbalance)***

- **Description** : An epidemic or sanctions of “moderate severity” that unbalance global finances and lead to the suspension of contracts with reference to Force Majeure .
- **Actions** : Partial mothballing of selected support facilities, revision of contracting strategies and reduction of staff numbers .
- **Objective** : Minimize operating costs while maintaining basic infrastructure.

#### ***3. Very bad scenario (Deep recession)***

- **Characteristics** : Long-term disruption of economic ties, withdrawal of national and Russian companies, cessation of funding .
- **Actions** : Complete conservation of unfinished construction projects (start-up complex) to prevent their destruction under environmental influences .

- **Objective** : Transfer the construction site to the status of “investment reserve” .

#### **4. A particularly bad scenario (Spontaneous closure)**

- **Characteristic** : Uncontrolled and unjustified closure of a site due to military action or political ruptures without the implementation of compensatory measures .
- **Actions** : Emergency bringing of the site to an environmentally safe state that does not require constant monitoring, and development of measures to counteract the loss of information about the facility .
- **Objective** : To prevent colossal reputational and irreparable material losses .

### **Chapter 6. Relationship between Scenario Planning and Technical Conservation Regulations**

The logical connection between **Scenario Planning** and **the Technical Preservation Regulations** is the connection between "strategy" and "tactics." While the scenario determines *why* and *for how long* we shut down, the regulations answer the question of *how exactly* we physically preserve the facility for that duration.

Below is a logical chain linking these chapters:

#### **6. 1. Scenario as a “Technical Assignment” for the regulations**

The scenario sets **the depth and duration** of conservation, which directly determines the scope of technical work:

- **In the Soft Scenario** : The Regulation is limited to an “operational pause” – protecting exposed concrete areas and equipment for a short period of time without dismantling.
- **In a Very Worst-Case Scenario** : The Regulation switches to a “deep conservation” mode – bringing buildings and structures into a condition that does not require oversight by regulatory authorities and ensures the durability of the structures for years to come.

#### **6. 2. Optimization criteria: Time and Money**

The connecting link is **the performance criteria** specified in your work:

- **Time indicators** : The scenario predicts the duration of the crisis (for example, a 20-year failure, as in the case of Angra-3), and the regulations select appropriate technologies for protecting metal structures.
- **Cost indicators** : Economics (20-30% of the cost of a new unit) dictates the choice of technical measures in the regulations. If the worst-case scenario is considered, the regulations should specify the minimum mandatory work to protect the facility as an investment reserve.

#### **6 . 3. Information continuity**

Scenario planning takes into account the risk of "**inevitable loss of some information**" during extended downtime. Technical preservation regulations include "compensatory measures" for digitizing and archiving data so that engineers have a complete picture of the facility's condition when transitioning to the "Startup" scenario.

#### **6. 4. Legal legalization of the technical process**

The scenario justifies **the appropriateness of the expenditure** to the investor and the state. The regulation, however, provides **evidence** that the measures taken are "reasonable" and consistent with international methodologies (AFRY), allowing for a legally protected position in the event of disputes.

#### **6 . 5. Communication Summary:**

**Scenario planning defines the event horizon and risks, and the Technical Conservation Regulations translate these risks into the language of engineering solutions, ensuring the physical survivability of the NPP as an asset.**

#### **Chapter 7. Technical conservation regulations**

Technical conservation is a set of measures to bring the territory and structures into a condition that ensures their strength and safety .

- **Condition assessment** : Identification of environmental impact parameters on structures and assessment of the possibility of continuing construction in the future .
- **Protection of structures** : Carrying out the minimum mandatory conservation work (start-up complex) to protect against physical destruction .
- **Maintenance and control** : Determining the amount of funds for protection, monitoring and maintaining the facility in a mothballed state .
- **Administrative Measures** : Revise contract structures to ensure site security, power supplies, and facility maintenance during downtime .

**Summary: Controlled shutdown is an expensive process (up to 30% of the construction cost), but it is the only way to preserve the possibility of subsequent resumption of work .**

#### **Chapter 8. The Economics of Conservation**

Preservation is not about "freezing" funds, but about protecting them.

- **Cost justification** : The total cost of decommissioning and mothballing a single power unit can range from **20 to 30%** of the cost of constructing a new, comparable facility .
- **Time dependence** : The cost depends significantly on the period for which the process is suspended .
- **Investment reserve** : Justified conservation allows the use of unfinished construction as an investment reserve for future effective use .
- **Maintenance and security** : It is necessary to determine in advance the amount of funds for monitoring and maintaining the facility, as well as for the possible reuse of the industrial site .

#### **Chapter 9. Technical regulations for conservation**

The technical side of the issue is designed to stop the physical destruction of the object.

- **Material protection** : Application of developments in the field of preservation of concrete and metal structures to prevent the risk of their destruction or damage .

- **Environmental protection** : Identification of the minimum required works to protect structures from external physical environmental influences .
- **Counteracting information loss** : Developing compensatory measures against the inevitable loss of part of the information about an object that occurs during downtime .
- **Environmental safety** : Bringing buildings and structures into a state that does not require constant monitoring by regulatory authorities .

## Section III. Force Majeure: Military Actions and Political Ruptures

While form minors allow us to maneuver within a project, this section is dedicated to extreme conditions, when the project's existence as a whole is directly threatened. Here, we move from engineering adaptation to asset survival strategy.

### Chapter 10. Security in the Zone of Conflict and Political Ruptures

This chapter examines scenarios where normal functioning of the site is impossible due to external power or global political factors.

#### *10.1 . Geography of risks: NPP territory vs. vendor territory*

We differentiate approaches depending on the localization of the conflict:

- **Activities at the host site (customer country):** The primary priority is the physical protection of unfinished facilities and environmental safety. Bringing the site to a state "that does not require constant monitoring by regulatory authorities" to minimize personnel presence in the risk zone.
- **Conflict within the vendor's territory (Russia) or transit countries:** The main risk is a complete blockage of logistics and financing. This is where the "digital preservation" mechanism and intellectual property protection come into play.

#### *10.2 . Emergency bringing to a safe state*

Unlike planned conservation, force majeure requires "lightning-fast" decisions:

- **Minimum set of compensatory measures:** List of works that must be completed within 48-72 hours to prevent man-made consequences.
- **Site autonomy:** Providing facilities with temporary power sources and monitoring systems capable of operating automatically.

### Chapter 11. Legal and reputational protection

This chapter answers the question of how to resolve the situation with minimal legal losses while maintaining Rosatom's status as a bona fide partner.

#### *11.1 . Mechanisms for protecting investor rights in the international field*

- **Documenting Force Majeure:** Using internationally recognized methodologies (including AFRY's practices) to legalize the suspension of operations. This is necessary to avoid accusations of "unreasonable and uncontrolled closure."
- **Preventing nationalization:** Legal justification for the fact that a mothballed object is an "investment reserve" the rights to which remain with the party that carried out the mothballing.

## ***11.2 . Preserving reputation and “clean” suspension***

As noted earlier , the worst thing is a spontaneous closure.

- **Communication Strategy:** Formal notification to stakeholders that the shutdown is a measure to ensure the safety and security of the future facility, and not a waiver of obligations.
- **Transformation into contractual specifications:** Translation of force majeure conditions into clear additional agreements that describe the conditions and procedure for future renewal (Restart).

## **Chapter 12. Countering the Loss of Critical Information and Protecting Intellectual Property (IP)**

In the context of political rifts, information becomes more vulnerable than metal.

Force majeure doesn't mean the end of a project. It simply means the project enters a state of "suspended animation," where information security, legal protection, and technical autonomy allow it to wait for a change in the political climate.

Protecting intellectual property (IP) and the rights of project participants during the liquidation of legal entities is critical to preserving the "genetic code" of a nuclear power plant. In the nuclear industry, where the life cycle of a facility spans centuries, the legal death of the designer should not mean the technical death of the project.

Below are detailed mechanisms for protecting rights in extreme conditions.

### ***12. 1. Protection of intellectual property (IP)***

In force majeure situations, information becomes more vulnerable than concrete structures . The following measures are being taken to protect the know-how of Rosatom and its partners:

- **Digital Preservation Mode** : Creation of secure mirror archives of all design and executive documentation on independent servers within the vendor's jurisdiction .
- **Documentation escrow agents** : Transferring source codes for automated process control systems and critical calculations to trusted international or national depositories, which grant access only when clearly defined conditions are met (for example, to ensure the security of an object in the event of the vendor's disappearance).
- **Marking and legal binding** : Inclusion in each drawing and specification of a limited right to use clause that is not revoked by suspension of contracts .

### ***12.2. Protection of the rights of the General Designer***

The general designer is responsible for the integrity of the project. Their rights are protected through:

- **Author's supervision as an inalienable right** : A clause is included in intergovernmental agreements (IGAs) stating that any changes to the project ("form minors") can be made only with the consent of the holder of the basic project or his legal successor .

- **Veto power during de-commissioning** : Establishment of regulations according to which re-starting of construction is impossible without an audit by the General Designer to assess the environmental impact on the structures .

### ***12.3. Protection of the rights of the Equipment Manufacturer***

Manufacturers often find themselves held hostage by sanctions or bankruptcy. Their interests are protected as follows:

- **Retention of Title** : Contracts stipulate that ownership of the equipment will only transfer to the customer after full payment, even if it is already in storage on site .
- **Certification Continuity** : Ensuring that when a manufacturer changes (form minor), the intellectual property rights to test methods and safety certificates remain protected .

### ***12.4. Actions upon termination of the copyright holder's existence***

This is the most complex legal scenario, requiring mechanisms for the “inheritance” of rights and obligations:

- **Appointment of the “Technical Successor”** : In the structure of the State Corporation Rosatom (or similar structures of the customer), institutions are determined in advance to which the intellectual property rights and the functions of the archivist are transferred in the event of the liquidation of a specific design institute or plant .
- **Transfer to the "Public Domain under State Control"** : If the copyright holder has disappeared, the rights to critical safety documentation (Safety Case) may be transferred to a national regulator or a specialized state fund to ensure the possibility of completion or safe dismantling .
- **Compensation fund** : Creation of a financial reserve (the same 20-30% of the cost), which can be used by the successor to update the project after a long pause .

**Summary** : The protection of rights in the nuclear energy sector is based on the principle of "continuity of security." Legal entities may disappear, but rights to documentation and technical solutions must remain vested in state or international entities capable of ensuring the project's completion.

## **Section IV. The Path to Revival: Restarting the Project**

This section is devoted to the transition from conservation mode to active construction.

### **Chapter 1 3. Criteria and stages of resumption of construction**

Restarting a project is not a continuation from where you left off, but a process of deep revision and updating.

#### ***1 3 .1. Technical audit and condition assessment***

- **Environmental Impact Analysis** : Conducting a study of the destruction or partial damage of structures that occurred during downtime .
- **Assessment of the possibility of continuation** : Expert opinion on the suitability of the object for further construction based on the actual condition of concrete and metal .

- **Equipment inventory** : Checking the safety of mothballed equipment and identifying components that require repair or complete replacement due to obsolescence (“form minors”).

### **1 3 .2. Updating the project and the legal framework**

- **Review contract strategies** : Securing new contracts for safety, maintenance and commissioning of facilities .
- **Adaptation to new standards** : Adjustments to design documentation to take into account changes in national legislation and international safety standards that have occurred during the pause .
- **Restoration of the information base** : Compensation for lost information about an object through on-site surveys and restoration of digital archives .

### **1 3 .3. Economic efficiency of the “exit”**

- **Start-up Cost Estimate** : Determine the amount of funds required to decommission, reuse the site, and update systems .
- **Using the investment reserve** : Realizing the benefits of the saved “investment reserve” over building from scratch .

## **Section V. Global experience: “Safe pauses” in world practice**

This special section is devoted to analyzing global experiences with the suspension and resumption of nuclear power plant construction. While the Akkuyu project and Rosatom’s experience at Belene are unique, global practice knows numerous examples of how political rifts, trade wars, and financial crises have turned construction sites into "technological hostages."

Russian projects aren’t the only ones facing the need for "project maneuvering." The global nuclear energy market has repeatedly demonstrated that without a clear mothballing methodology, projects either fail or require colossal overpayments upon restart.

### **Chapter 1 4. International cases of suspension and resumption**

<b>Project / Country</b>	<b>Reason for stop</b>	<b>Duration of pause</b>	<b>Summary and lessons learned</b>
<b>VC Summer (USA)</b>	Vendor’s financial crisis, management errors	—	<b>Project cancellation</b> after \$9 billion in costs. Lesson: The lack of a plan B during a personnel and engineering crisis leads to a complete loss of the asset.
<b>Kashiwazaki-Kariwa (Japan)</b>	Man-made force majeure (Fukushima) and seismic events	<b>14 years old</b>	<b>A successful restart in 2026.</b> Lesson: the need for a thorough modernization of the automated process control system and safety systems before launch.
<b>Eurodif (France/Iran)</b>	Political sanctions	—	<b>Supply blockages</b> and long-standing legal disputes. Lesson: Political sanctions make suppliers

			"untrustworthy" in the eyes of customers, requiring independent solutions.
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## Chapter 1 5. Legal Shields in International Law

To protect investors and developers in conflict zones, international law (IHL) and bilateral agreements create "safe zones":

- **Prohibition of attacks** : Article 56 of Additional Protocol I to the Geneva Conventions expressly prohibits attacks on nuclear power plants, even if they are military objectives, if this may result in the release of dangerous forces.
- **Bilateral safeguards** : An example is the agreement between India and Pakistan (1988) prohibiting any actions aimed at damaging or destroying each other's nuclear facilities.
- **IAEA Standards** : *The Nuclear Energy Series* sets a global standard for project management at all stages, including long-term mothballing, providing a legal basis for cost justification to regulators.

## Chapter 1 6. Moral obsolescence: The main "form minor"

The experience of the restart in Japan (2026) and the USA (Vogtle) has shown that during the "pause" technology moves forward:

- **Knowledge deficit** : If a pause of more than 10 years occurs, a "generation of experience" is lost, and new engineers are forced to re-learn the project.
- **Digital divide** : Control systems designed 20 years ago often cannot be integrated into modern networks without a complete replacement of the component base.

## Final summary of the work

"Form Minors and Force Majeure" project demonstrates that in 2026, the survivability of a nuclear project depends not only on the strength of its concrete but also on the flexibility of its legal and engineering algorithms. We propose not just "mothballing," but a **"Technological Suspended Annihilation" strategy** that allows the project to weather any storm and be reborn when it becomes possible.

**The main topic of the work is** Ensuring technological sustainability and preserving the investment value of unfinished nuclear power plant construction projects in conditions of global instability.

Our work shows that a "safe pause" in nuclear construction is a complex but manageable process. A key factor for success is abandoning the "stage-by-stage and protracted" approach to addressing issues in favor of immediate bilateral discussions and the transformation of proposals into strict contractual specifications .

### 1. Statement of the current situation

- Against the backdrop of geopolitical turbulence and sanctions restrictions, the risk of unjustified and uncontrolled termination of construction projects is becoming critical

- Underestimating the risks of spontaneous site closures leads to irreparable material damage (up to 30% of the facility's value) and the loss of the ability to resume work in the future (up to 100 % of the facility's value)
- Existing conservation methods require adaptation to the conditions of multinational construction sites and rapidly changing national legislation .

## 2. Strategic directions of action (Project "Safe Pause")

Only a comprehensive consideration of initial events, the development of scenarios (from mild to particularly bad) and the creation of a reliable legal and technical foundation will make it possible to avoid irreparable material and reputational losses in the context of global instability .

The work under consideration is devoted to the implementation of an integrated approach, including:

### A. Technical regulations and innovations:

- Conducting a comprehensive review of initial events under four scenarios (Mild, Average, Very bad, Particularly bad) .
- Development of minimum mandatory works for the preservation of the launch complex to protect structures from external physical influences .
- Implementation of methods for preserving concrete and metal structures based on the experience of the Angra-3 and Belene projects .

### B. Legal and intellectual protection:

- Development of amendments to the legal acts of the countries of presence to protect the rights of developers and investors during the period of suspension of work .
- Establishing regulations for “digital preservation” to prevent the inevitable loss of some information about an object .
- Legal consolidation of the status of unfinished construction as an “investment reserve” .

### B. Contractual and personnel adaptation:

- Adjust contract strategies to ensure site security, equipment support, and retention of key personnel during downtime .
- Review of contract structures to recognize pandemics and sanctions restrictions as force majeure events .

## 3. Proposed steps for implementation

1. **Immediate consultations:** Move to bilateral discussions via videoconference to transform these proposals into contractual specifications .
2. **Pilot project:** Propose the Akkuyu NPP construction site as a base for testing methods for legal and technical justification of mothballing .
3. **International Validation: Leverage** NUCON's expertise to validate proposed solutions internationally and align them with national regulators .

## **Final Provision**

We emphasize that the worst-case scenario is an "uncontrolled spontaneous closure." This work aims to create the preconditions for a controlled "pause" mechanism that will guarantee the safety of the facility for the population and the environment, as well as preserve the project's economic value for future generations .