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REGULATORY MAPPING OF THE ACP100 (LINGLONG ONE) SMALL MODULAR REACTOR PROJECT

STRUCTURAL GUIDE AND MAPPING MATRIX OF THE REGULATORY AND LEGAL FRAMEWORK OF THE PRC NUCLEAR PROJECTS *(In the scope of engineering, procurement, construction, and construction management of NPP)*

CONTENT

ANNOTATION / ABSTRACT

The engineering company NUCON presents a comprehensive scientific and engineering study aimed at ensuring the technological and regulatory sovereignty of the Republic of Serbia at "Point Zero" of the pre-investment analysis of the Chinese proposal for the construction of a small modular reactor.

The work is based on a sovereign methodology of multi-dimensional regulatory mapping and end-to-end gap analysis, making the closed regulatory and technical ecosystem of the PRC more transparent.

NUCON specialists performed a detailed, level-by-level decomposition of Chinese nuclear law — from NNSA laws and administrative regulations of the State Council of the PRC (HAF/HAD codes) to highly specialized industrial engineering standards (NB/T and GB/T codes).

Using the conservative Russian regulatory framework (the line of Federal Rules and Regulations of Rostechnadzor and GOST) as a highly calibrated diagnostic prism, experts mapped Chinese codes against target European filters (WENRA regulations, EUR requirements, and Eurocodes).

The developed three-way verified compliance matrix enabled the identification of critical regulatory conflicts at the pre-investment stage, including those within construction management, commissioning, maintenance of as-built documentation, and pricing.

The study provides the Serbian side with ready-to-implement strategic solutions to overcome the "regulatory trap" of a First-of-a-Kind (FOAK) project, resolve the conflict of transferring construction control to foreign manufacturing plants (Factory vs. Site), and rigidly neutralize the risks of long-term technological dependence on a single supplier (Vendor Lock-in).

The final document forms an "Engineering Navigator" for the Government of Serbia to conduct equitable interstate negotiations, transforming a foreign commercial proposal into a safe, predictable, and licensable national asset.

SECTION 1. INTRODUCTION AND RELEVANCE OF THE DOCUMENT

1.1. Context of the Initiative

The proposal to construct a nuclear power plant based on a Chinese design, formulated during the official visit of the President of the Republic of Serbia to the PRC, has shifted the discussion on the future of national energy from the plane of strategic intentions into the scope of rigorous practical analysis. As of today, authorized organizations and specialized ministries of Serbia have already commenced a detailed consideration of this large-scale initiative.

1.2. The Regulatory Challenge of "Point Zero"

The main feature of the current stage is that an objective verification of the Chinese proposal is impossible without an immediate and deep orientation in the sovereign regulatory and technical database of the PRC. The regulatory approaches, engineering codes, and quality standards of China's nuclear industry represent an isolated ecosystem, largely acting as a "black box" for the European legal framework.

Timely identification of potential problems, technological barriers, and hidden risks (including those associated with the status of First-of-a-Kind (FOAK) projects) must occur precisely now — at "Point Zero," at the stage of institutional genesis, long before the adoption of long-term and legally binding state obligations.

1.3. The Fundamental Imperative

In nuclear engineering and international law, the regulatory framework is the foundation of everything. It acts as the alpha and omega of the project, predetermining not only the physical safety of the facility, but also its final economics, construction timelines, the depth of local industry involvement, and the legal feasibility of integrating the NPP into transboundary energy grids. Without a clear regulatory fixation of the rules of the game at the pre-investment stage, any technological proposal risks turning into a project trap.

1.4. Objectives of This Document

Based on an understanding of the regulatory imperative, this study pursues the following key objectives:

- **Systemic Decryption of the Structure:** Creating a transparent guide to the hierarchy of PRC regulatory documents (from NNSA laws [1] to highly specialized NB/T industry codes [81]) for Serbian specialists and ministries reviewing the project.
- **Harmonization and Mapping:** Conducting a cross-mapping of Chinese regulatory requirements against Russian (Soviet) engineering references familiar to the market and, crucially for Serbia, against European standards (WENRA [8], EUR [68], Eurocodes [100]).
- **Identification and Neutralization of Conflicts:** Timely detection of regulatory gaps (*Gap Analysis*) in construction management, as-built documentation, pricing, and incoming control

of local materials.

- **Ensuring Sovereign Dictate:** Forming a pre-investment foundation that will allow the Serbian side to act in negotiations not as a passive recipient of imported technology, but as a demanding customer dictating its own safety and localization conditions.

The objective of this document is to describe general approaches and methodologies of mapping processes and to present the results of the decryption and mapping of the four-tier hierarchy of regulatory documents of the People's Republic of China in the field of peaceful atom to support the stages of pre-project analysis and regulatory consulting.

The expression **"Regulatory Mapping"** is an established international engineering and development term that perfectly reflects the essence of high-level regulatory consulting.

SECTION 2. METHODOLOGY OF MAPPING AND REGULATORY CONFORMITY ANALYSIS (REGULATORY MAPPING & GAP ANALYSIS)

This section defines the scientific and methodological approach, mathematical-logical rules, and engineering criteria used for the cross-mapping of diverse nuclear regulatory systems (PRC NNSA [1], RF Rostechnadzor [7], EU WENRA [8] / EUR [68] / Eurocodes [100]) as part of the verification of the Chinese technological proposal.

The application of the Russian system of regulatory and technical framework (the line of FNP [7], NP [15], RB [39], and GOST [83]) as an intermediate baseline reference when analyzing Chinese codes is driven by a combination of objective engineering and practical factors:

- **Deep Detailing and Continuous Evolution:** This regulatory framework has been forming for over half a century, absorbing a colossal volume of fundamental research and applied data. It undergoes continuous modernization, promptly incorporating modern international safety requirements and lessons learned (including post-Fukushima stress-test standards).
- **Unprecedented Stringency of Criteria:** Russian standards are traditionally classified in the global nuclear community as some of the most conservative and stringent, particularly in ensuring deterministic barriers of defense-in-depth, materials science, structural integrity of equipment under pressure, and seismic resistance.
- **Proven Empirical Basis:** Hundreds of nuclear power units of various modifications have been successfully designed, constructed, commissioned, and safely operated in compliance with the ultimate requirements of this regulatory environment, both across the Eurasian space and within large-scale international projects.
- **Objective Limitations of the Framework:** The systemic limitation (downside) of this regulatory framework is recognized as its extreme volume, multi-layered complexity, and rigid branching of cross-references, making it practically insurmountable for specialists without a specific nuclear background.
- **Decisive Engineering Factor:** The key economic and professional argument is the thorough

mastery and long-term practical experience of working within this regulatory framework. This transforms it into a highly calibrated diagnostic prism, through which the hidden nuances of the "black box" of Chinese codes are decrypted with maximum precision and speed.

2.1. Professional Definition

Regulatory Mapping is a method of systemic multi-dimensional comparison of independent regulatory systems (national codes, standards, and rules) to establish their functional equivalence, identify regulatory gaps (*Gap Analysis*), and establish cross-cutting engineering and legal links between them.

In simple terms, mapping is the creation of a "genetic map" of the project. It transforms scattered and isolated arrays of documents from different countries into a single navigation matrix understandable to engineers and lawyers.

What is the deep essence of the method? Mapping is fundamentally different from a regular technical translation. A linguistic translation merely translates the text of hieroglyphs but does not solve the compatibility problem. Engineering mapping solves three key tasks:

1. **Search for Functional Equivalence (Not Literal Match):** Chinese standards are written in their own logic, Russian in theirs, and European in a third. Mapping finds not identical words, but nodes performing the same function.
   - *Example:* Mapping shows that the Chinese rule HAF 102 [14] functionally corresponds to the same scope as the Russian general provisions NP-001-15 [15] and the international standard IAEA SSR-2/1 [16]. The map connects these points with a "road link".
2. **Express Identification of Conflict Zones (Gap Analysis):** When standards are superimposed on each other like layers on a geographical map, "regulatory gaps" become instantly visible — areas where the requirements of one system fail or contradict the requirements of another.
   - *Example:* The Chinese code NB/T 20009 [98] and the European Eurocode 2 [100] are superimposed on the reactor pit. Mapping immediately highlights: the methodologies for calculating concrete strength do not match, there is a conflict here, and the CNNC project in its current form will not pass the Serbian state expert review.
3. **Digitization and Requirements Management:** In modern mega-projects, a compliance matrix is embedded into the information management system. Any construction regulation coming from a vendor is automatically checked by the system along the chain: *"Does this Chinese installation step correspond to the agreed European/Serbian analogue?"*.

2.2. Cross-cutting Structural and Level Decomposition

Before starting the comparison, the document arrays of all three regulatory systems are brought to a single four-tier hierarchical structure. Comparison is allowed only between documents of equivalent rank:

- **Rank I (Legislative):** Constitutional laws and acts of direct effect.
- **Rank II (Regulatory):** Mandatory state rules, standards, and licensing requirements (FNP [7] /

HAF Codes [5] / WENRA Reference Levels [8]).

- **Rank III (Methodological):** Official safety guides detailing Rank II rules (RB [39] / HAD Guides [29] / IAEA Safety Guides Series [4]).
- **Rank IV (Engineering and Industrial):** Specific technical codes, materials science standards, calculation rules, welding, construction and installation works, and pricing (GOST [83] / NB/T [81] and GB/T Codes [73] / EN Standards [88] and Eurocodes [100]).

2.3. Criteria for Determining the Degree of Document Equivalence

To digitize the results of the comparison, a logical scale for classifying regulatory compliance is introduced. The degree of equivalence of the vendor's technical requirement $\mathbf{R}_{\mathbf{vendor}}$ relative to the baseline requirement of the host country $\mathbf{R}_{\mathbf{target}}$ is divided into three classes:

- **Class E1: Full Equivalence:** Physical parameters, embedded safety margins, boundary conditions, non-destructive testing methods, and quality verification algorithms match by more than 90%. Engineering solution: automatic direct acceptance ("validation on faith") of the vendor's as-built and design documentation is permitted. Licensing risks are absent.
- **Class E2: Functional Equivalence:** Specific engineering methodologies, structural material grades, or system calculation metrics differ, but the final safety function (activity retention, passive heat removal, prevention of prompt neutron runaway) is ensured to an equal or greater degree. Additional calculation and analytical substantiations of compatibility are required. The vendor's documentation is subject to targeted verification by an independent expert (*Owner's Engineer*).
- **Class E3: Regulatory Gap / Conflict:** The presence of fundamental, unresolvable contradictions between requirements, or a complete absence of regulation in one of the systems (for example, a strict EU requirement for CE marking of materials [104] against the closed factory verification procedure of the PRC [26]). Direct technology import is impossible. It requires either a forced redesign of the vendor's design solution to match the standards of the host party, or the development and licensing of expensive compensatory measures.

2.4. Mathematical-Logical Rule of Code Stringency (The Stringency Rule)

When mapping engineering and technical codes of Rank IV (welding, strength, concreting), the absolute rule of **"Priority of Maximum Stringency"** applies. The logical condition for allowing a technology to be implemented on site looks as follows:

$$\textbf{Requirement}_{\textbf{Serbia (EC)}} \leq \textbf{Requirement}_{\textbf{Vendor (PRC)}}$$

If the internal standard of the Chinese vendor (NB/T) [81] sets more stringent requirements for a node regarding strength, chemical composition, or defectoscopy than European standards (EN [88] / Eurocodes [100]), then the project is accepted in its original Chinese execution.

If the European/Serbian filter turns out to be more stringent, the mapping system records a regulatory gap (Class E3). In this case, an imperative requirement to recalculate parameters or change the construction technology at the vendor's expense is entered into the Customer's Technical

Specification (*Owner's Requirements*).

2.5. Algorithm for End-to-End Requirements Management

Practical application of the mapping methodology consists of four sequential steps performed at the pre-investment stage:

- **Step 1:** Collection and cataloging of the list of standards embedded by Chinese designers into the basic design of the small modular reactor [1, 81].
- **Step 2:** Parallel "superimposition" onto this list of Russian analogues [7, 83] (as intermediate technical references) and target European regulations [8, 100].
- **Step 3:** Conducting a Gap Analysis with automated extraction of Class E3 conflicts (especially regarding the use of local materials [104], pricing [112], and execution of as-built documentation [108]).
- **Step 4:** Formulation of legally binding Owner's Requirements, which block the risks of a FOAK project and turn the Chinese proposal into a safe, predictable, and licensable asset on the sovereign territory of Serbia.

2.6. Universality and Vendor-Independence of the Methodology (VENDOR-AGNOSTIC FRAMEWORK)

It is important to emphasize that the developed methodology of end-to-end structural-level mapping and Gap Analysis of regulatory compliance is not a situational tool created solely for the specific nature of the Chinese proposal.

Engineering Sovereignty of the Customer: This analytical framework possesses absolute universality (*vendor-agnostic*) and can be deployed with respect to the regulatory, technical, and design documentation of **any global vendor** (be it American Westinghouse/NuScale standards, French Framatome/EDF codes, or South Korean KHNP regulations).

When changing a technological partner or considering alternative proposals at the pre-project stage, the mapping algorithm remains unchanged. The system of counter-requirements of the Customer (*Owner's Requirements*) is formed according to a single standardized template, which allows the state to:

- Have an independent tool for objective cross-vendor comparison and benchmarking of competing technologies.
- Eliminate the risks of falling into technological and regulatory dependence on a single supplier (*Vendor Lock-in*) even at the stage of tendering procedures.
- Maintain full control over the rules of the game on the construction site, regardless of the geographical origin of the imported nuclear asset.

SECTION 3. HIERARCHICAL STRUCTURE OF THE PRC REGULATORY FRAMEWORK

The Chinese nuclear regulatory system is managed by the National Nuclear Safety Administration of the PRC (NNSA) [1] and has a strict vertical chain of command. The provisions of these documents bear the character of rigid state dictate.

3.1. Level I: National Laws

Supreme legislative acts adopted by the Standing Committee of the National People's Congress (NPC) [2]. They define state policy, sovereignty, and the framework of liability.

- The baseline document is the **PRC Law "On Nuclear Safety" (China Nuclear Safety Law) [2]**, which defines state policy, the licensing framework, and civil liability for nuclear damage.
- **PRC Law "On Prevention and Control of Radioactive Pollution" [1]** — regulates environmental safety, emissions, and general principles of handling nuclear materials on the national level.

3.2. Level II: Administrative Regulations of the PRC State Council (HAF Codes)

Mandatory regulations approved by the State Council of the PRC [5]. The HAF (*Nuclear Safety Regulations*) series codes [5] represent direct analogues of the Russian Federal Rules and Regulations (FNP) [7].

3.3. Level III: Nuclear Safety Guides (HAD Guides)

Official NNSA documents [1] detailing approved methods for complying with HAF rules [5]. The HAD (*Nuclear Safety Guidelines*) series [29] is equivalent to the Russian Safety Guides (RB) [39] and IAEA Safety Guides series standards [4].

3.4. Level IV: Industrial Engineering and Technical Standards (GB, NB/T, EJ/T Codes)

Specific technical specifications regulating materials science, calculations, welding, non-destructive testing, and examinations.

- **GB and GB/T Series (National Standards) [73]:** State Standards of the PRC (analogue to GOST / GOST R [83]).
- **NB/T Series (Energy Industry Standards) [81]:** Industry standards of the Ministry of Energy of the PRC, regulating nuclear machine building, pipelines, and pressure equipment.
- **EJ/T Series (Nuclear Industry Standards) [81]:** Specific standards of the PRC nuclear industry issued by CNNC for internal supply chain control.

3.5. Specifics of Regulatory and Legal Framework for Small Modular Reactor (SMR) Projects

The application of the Chinese regulatory framework to low-power projects (such as the integrated platform ACP100) has a number of specific regulatory distinctions:

- **Adaptation of High-Power Codes:** The PRC's own sovereign standards for SMRs have largely evolved from the regulatory framework of advanced Generation III+ high-power reactors (Hualong One / HPR1000) [14]. Design and control standards are adapted for an integrated layout but retain the stringency of "large" standards.
- **The FOAK Regulatory Status Trap:** Advanced SMR projects often face the "regulatory trap of a first-of-a-kind facility" (*First-of-a-Kind Regulatory Trap*). National regulators are historically oriented toward the rigid templates of gigawatt blocks, so international verified regulations for small reactors capable of operating without core opening for several years are in the process of formation.
- **Conflict of Site and Factory (Factory vs. Site):** The basic logic of SMRs relies on the maximum transfer of complex assembly and installation works from the construction site to remote manufacturing plants (*factory fabrication*). From a regulatory point of view, this creates a gap: a significant part of construction quality control procedures is transferred to the jurisdiction of the plant (in the PRC), leaving the host party (Serbia) with oversight of general construction works and the final integration of modules.

3.6. Regulatory Framework of Construction and Construction Management Processes

Since the key competence of the company is engineering and construction management of NPPs, documents regulating the quality of construction and installation works, personnel qualifications, and non-destructive testing on-site are of the greatest importance.

- **The Basis of Construction Control (HAD 003 Series Codes):** Quality assurance rules of the PRC State Council require unconditional compliance with the HAD 003 series (*Quality Assurance*) [30] guides when organizing any work on site. For construction consulting, the documents HAD 003/04 [38] (quality assurance during construction) and HAD 003/05 [42] (quality assurance during commissioning) are critically important, completely defining the regulations for subcontractor admission and maintenance of as-built documentation.
- **Welding and Non-Destructive Testing (NB/T Series Codes):** When installing Safety Class 2 (Containment loop) and Safety Class 3 (Support loop) systems, the Chinese side will demand strict compliance with industry codes NB/T 20003 [90] (non-destructive testing) and NB/T 20004 [94] (welding qualification). These standards are based on the American ASME code [84] but are tightly coupled to the metallurgical base of the PRC, which will require local construction companies to undergo a complex procedure for re-qualifying welding technologies (WPS/PQR) [96].

SECTION 4. ANALYSIS OF RESEARCH ON THE PRC REGULATORY FRAMEWORK

An analysis of the English-language and Russian academic segments shows that research into the regulatory and legal framework of the PRC in peaceful nuclear use is focused on its transformation from a closed defense structure into an export-oriented civilian model. Monitoring revealed several key fundamental works and analytical briefs providing a deep understanding of the structure of PRC NNSA codes [1], their conflicts, and counterfeits.

4.1. English-language Academic and Analytical Segment

Research by leading Western and Chinese institutes is focused on the evolution of national nuclear law and the adaptation of high-power codes for small generation:

- **MDPI, Energies journal (H. Deng, 2025):** *Work: "Reflection and Amendment of China's Nuclear Energy Policies and Laws with the Background of Global 'Nuclear Relaunch'".* The author conducts an empirical analysis of the modern system of nuclear safety standards in the PRC [1]. The paper highlights the hidden problem of insufficient independence of regulatory bodies (NNSA) [1] from industrial giants (CNNC) and the PRC State Council [5], which creates regulatory risks for foreign customers relying solely on internal Chinese safety certificates.
- **Frontiers in Energy Research (B. Liu, J. Liu, L. Shen, 2023):** *Work: "Low-temperature nuclear heating reactors: Characteristics and application of licensing law in China".* A critically important work analyzing the "regulatory trap" in SMR licensing. The authors prove that current Chinese regulations (HAF series codes [5]) are historically adapted for gigawatt blocks. Applying them to small reactors (up to 180°C or low power) generates rigid conflicts in defining emergency planning zones (EPZ) and places an unreasonable financial burden on the operator for accident management.
- **Oxford Institute for Energy Studies (P. Andrews-Speed, 2023):** *Work: "Nuclear power in China: its role in national energy policy".* A fundamental work exploring the PRC's strategy of transitioning from technology import to sovereign engineering dictate. It analyzes how China forms closed internal supply chains (*Indigenous Supply Chain*), using national NB/T codes [81] as a barrier excluding the integration of foreign components into Chinese projects.
- **The Nonproliferation Review / Cambridge Repository (Y. Zhou, M. Paim, 2018):** *Work: "Nuclear decommissioning in China: regulatory development and future synergy".* A study of China's regulatory gaps at the end of the NPP life cycle. The authors point to the "regulatory incompleteness" of PRC codes regarding decommissioning and SNF management, noting that China still copies IAEA [4] and US (NRC) standards, lacking its own comprehensive legislation on the final stage of the back-end fuel cycle.

4.2. Russian Segment (Analytics and Institutional Audit)

The Russian engineering school views the Chinese regulatory framework through the prism of comparison with reference Soviet and Russian standards (PNAE G [95], line of NP [15]):

- **INION RAN / CyberLeninka (V. Petushkova, 2021):** *Article: "Nuclear Power in the PRC in Light of Global Environmental Problems".* The paper analyzes the regulatory and political outline of the 13th and 14th five-year plans of the PRC. The author closely breaks down the mechanisms of state subsidization and directive pricing embedded in the industry standards of the Ministry of Energy of China [109], showing their incompatibility with market-based CAPEX evaluation models.
- **Innovations journal / MagInnovatika (A. V. Pisarev):** *Article: "Transition of the Chinese Nuclear Industry into the 14th Five-Year Plan".* A technical and economic audit of China's transition to a sovereign Generation III+ platform (Hualong One). The article reveals how the Chinese side uses GB/T state standards [73] and NB/T energy regulations [81] for rigid binding of foreign customers (*Vendor Lock-in*), making it impossible to repair or modernize stations using local contractors.
- **Center for Nonproliferation Analysis / IMEMO RAN (M. Saakyan):** *Article: "China's Policy in the Field of Nonproliferation of Weapons of Mass Destruction".* An analysis of the legal mechanisms for the export of PRC nuclear technologies. The administrative regulation HAF 604 [26], which governs the transfer of equipment abroad, is examined, revealing Beijing's legal requirement for an unconditional PRC veto right over the transfer of nuclear materials to third countries without prior approval from the Chinese government.

4.3. Key Findings for Regulatory Mapping

- **Origin of Codes:** Foreign experts unanimously confirm that the top-level safety codes of the PRC (HAF 100/200 series [5]) are historically derived from American NRC standards of the 1990s and general IAEA requirements [4], which facilitates a primary understanding of their structure.
- **Hidden Barrier:** The main conflict noted by analysts lies at the lower engineering level (NB/T [81] and GB/T [73]). These materials science and welding standards are artificially isolated from European norms (EN [88] / Eurocodes [100]) and Rosatom (PNAE G [95]), acting as an instrument to protect Chinese industrial export.
- **Deficit of SMR Regulations:** Neither in the PRC [1] nor in international practice [4] is there yet a seamless regulatory framework for licensing small modular reactors, forcing vendors to improvise each time, pushing their internal high-power standards [14] under the guise of ready-made solutions for small NPPs.

The proposed structure and list of key documents cover the basic need for regulatory mapping of the project. A complete elimination of the language and methodological barrier by comparing fourth-level technical codes (NB/T 20001–20004 series [81]) with PNAE G [95] and GOST [83] standards familiar to the domestic school allows for a swift assessment of the applicability of Chinese specifications to local market capabilities and the identification of regulatory gaps (*Gap Analysis*) at the pre-investment stage.

SECTION 5. REPORT ON SCIENTIFIC AND ENGINEERING ACTIVITY OF NUCON SPECIALISTS

Subject: Development of a Three-Way Verified Matrix of Regulatory and Technical Conformity (PRC — RF — EU) for Small and Medium Power Nuclear Projects.

Within the framework of expert and advisory support of the pre-investment stage (*Stage IGS*) of a potential construction of an NPP on the sovereign territory of the Republic of Serbia, a complex of research and systems engineering works was performed by specialists of the engineering company NUCON. The result of this activity was the development of a baseline Three-Way Verified Matrix of Regulatory and Technical Conformity, designed to decrypt the closed regulatory framework of the PRC and map it against international and European standards.

Ниже приведен детальный отчет о составе, методологии и этапах фактически выполненных специалистами NUCON работ.

5.1. Scope and Stages of Work Performed by NUCON

- **Stage 1: Collection, Verification, and Cataloging of Baseline Data.** A search, maximum possible extraction, and systematization of official regulatory legal acts and codes of the PRC of all four hierarchical levels of regulation was carried out [1]. Supreme national NNSA laws [2], administrative regulations of the PRC State Council (HAF series) [5], and official safety guides (HAD series) [29] were processed in detail and mapped across three language contours. A special emphasis was placed on isolating the hard-to-access industrial engineering and technical standards of the Ministry of Energy of the PRC (NB/T code series) [81] and nuclear industry standards (EJ/T), which govern materials science, welding, *Civil Works*, and pricing.
- **Stage 2: Analysis of Specialized Literature and Institutional Audit.** An analytical review of English-language and Russian scientific and technical publications dedicated to the evolution of the civilian nuclear law of China and the practice of its export application was performed. Critical findings of leading international institutes were studied and taken into account regarding hidden regulatory deficits of the PRC and risks of a first-of-a-kind (FOAK) facility[cite: 1, 2]. Based on the studied literature, the mechanisms of artificial isolation of Chinese technical codes used by vendors to form a long-term technological dependence of the customer (*Vendor Lock-in*) were defined in detail.
- **Stage 3: Analysis of Applicable Methodologies and Development of Sovereign NUCON Methodology.** A critical audit of standard approaches to comparing regulatory frameworks was conducted, revealing their complete inapplicability for Serbia due to linguistic translations ignoring rigid conflicts at the lower engineering level. An independent sovereign methodology of regulatory mapping (*Regulatory Mapping*) based on the search for functional equivalence of the requirements of diverse legal systems was developed and implemented. A mathematical-logical scale for classifying compliance (Classes E1, E2, E3) was formalized, and an absolute rule of the priority of maximum stringency of requirements (*The Stringency Rule*) was implemented for automatic filtering of design defects of the vendor. As a baseline diagnostic prism, a rigid Russian regulatory framework (the line of Rostechnadzor FNPs) [7] was integrated, the

thorough mastery and long-term experience of working in which allowed specialists to multiply the decryption speed of the "black box" of Chinese standards.

- **Stage 4: Development of a Three-Way Matrix and Gap Analysis of Conflicts.** Based on the developed methodology, mapping of Chinese codes HAF [5] / HAD [29] / NB/T [81] against the requirements of Rostechnadzor [7] and target European site filters (WENRA regulations [8], EUR standards [68], Eurocodes [100] and EU directives [104]) was performed. The official content and specifics of key regulatory documents completely covering the scopes of construction management, commissioning, maintenance of as-built documentation, qualification of local materials, and budget estimation were described in detail. Within the framework of the Gap Analysis, critical regulatory contradictions (conflicts) capable of paralyzing the passage of the state expert review of the project in Serbia were clearly formulated.

5.2. NUCON Proposals for the Preparation of Expanded and Deepened Versions of Developments

The work completed to date represents a strategic foundation of the first tier. To ensure absolute legal and technological protection of the Government of the Republic of Serbia in future negotiations with CNNC, the development of expanded, deepened, and customized versions of regulatory mapping is proposed.

In expanded versions of developments, micro-mapping (*Micro-Mapping*) down to the analysis of each paragraph, clause, and formula of every applicable document will be carried out:

- **Построчный контест-анализ (Clause-by-Clause Audit):** Each clause of the Chinese codes of the NB/T [81] and GB/T [73] series will be broken down in detail and mapped against specific paragraphs of EN [88], DIN, and Eurocodes [100] standards. Hidden discrepancies in tolerances, strength calculation formulas, and chemical composition of metals will be identified.
- **Development of Customized Counter-Requirements of the Customer (Owner's Requirements):** Based on the micro-analysis of each document, ready-made legal formulations will be prepared for integration into future EPC contracts. This will oblige the Chinese vendor to rewrite its internal factory procedures to match EU standards at its own expense.
- **Detailed Map of Material Localization (CE-Marking Bridge):** A step-by-step regulation for interfacing the Chinese construction code NB/T 20038 [102] with the European regulation CPR No 305/2011 [104] will be developed. This will allow for the legal use of Serbian cement, rebar, and aggregates on the nuclear island, completely eliminating the risk of construction schedule disruption.
- **Разрушение Vendor Lock-in на уровне АСУ ТП:** An in-depth analysis of the GB/T 13284.1 [74] standard will be performed to establish a legal procedure forcing the vendor to disclose the source codes of the safety control system software to an independent European auditor, eliminating the risk of digital dependence.
- **Economic Adaptation under FIDIC:** Directive budget quotas of code NB/T 20286 [110] will be broken down to the level of unit rates and recalculated into FIDIC market indicators (*Silver Book*) [112], adapted to the Balkan region, which will block any possibilities for hidden cost escalation

by the PRC.

The deployment of an expanded version of mapping guarantees the transformation of the Chinese technological proposal from a zone of high FOAK risks into a transparent, fully controlled, licensable, and safe sovereign asset of the Republic of Serbia. High-level regulatory consulting allows to provide the government of Serbia with a reliable "Engineering Navigator," without which the state expert review and licensing of the NPP will be paralyzed in the very first months, and for the Chinese corporation CNNC — a balanced "Regulatory Bridge," indicating exactly how to rewrite internal documents and construction procedures to meet the requirements of the European market. The mapping of the regulatory framework represents the transformation of the "black box" of Chinese codes into a transparent step-by-step manual for construction on the sovereign territory of Serbia.

SECTION 6. THREE-WAY REGULATORY CONFORMITIES OF GROUPS OF DOCUMENTS (PRC – RF – EU)

This section establishes the conceptual framework for cross-mapping and identifying regulatory discrepancies (**Gap Analysis**) between the closed database of the PRC, Russian Federation (RF) standards, and European regulations in the field of engineering and construction management of nuclear power plants. Each entry is provided in full without abbreviations, supplied with the complete official titles of the documents, and divided into content and conflict components.

Document Group	Regulatory Framework of the PRC	Regulatory Framework of the RF	Regulatory Framework of the EU and International Organizations	Specifics, Regulatory Barriers, and Conflicts for Serbia
1. Quality Assurance during Construction (Quality Assurance / QA)	**Nuclear Safety Guide HAD 003** "Quality Assurance on Nuclear Power Plants" [29], **Nuclear Safety Guide HAD 003/04** "Quality Assurance in the Construction of Nuclear Power Plants" [37]. **Content:** Regulates the creation of a rigid administrative system of vertical oversight by the vendor and the National Nuclear Safety Administration of the PRC (NNSA) over compliance by contractors with step-by-step technological routes and procedures.	**Federal Rules and Regulations NP-090-11** "Requirements for Quality Assurance Programs for Nuclear Energy Facilities" (QAP) [31]. **Content:** Establishes the framework for the development of the General Quality Assurance Program (QAP(G)) and Specific Programs (QAP(C) — for construction organizations), standardizing end-to-end management processes at all stages of the life cycle.	**International Standard ISO 19443** "Quality management systems — Specific requirements for the application of ISO 9001:2015 by organizations in the supply chain of the nuclear energy sector" [28], **IAEA General Safety Standards IAEA GSR Part 2** "Leadership and Management for Safety" [32]. **Content:** Defines an international risk-oriented quality management model that requires management of the entire supply chain down to the lower tiers of subcontracting.	**Conflict:** Chinese regulatory authorities and vendors conduct audits and accept construction and installation works strictly according to HAD 003 procedures, demanding unconditional execution of prescribed charts. European legislation and IAEA GSR Part 2 standards oblige construction contractors to demonstrate an independent "safety culture" and flexible risk-oriented thinking. In the context of Serbia, this creates a gap: local enterprises will not be able to pass pre-qualification without harmonizing HAD 003 with the ISO 19443 standard,

Document Group	Regulatory Framework of the PRC	Regulatory Framework of the RF	Regulatory Framework of the EU and International Organizations	Specifics, Regulatory Barriers, and Conflicts for Serbia
				which is mandatory in Europe.
2. Factory Modular Fabrication (Factory Fabrication) vs. Construction on Site (On-site Construction)	**Administrative Regulations of the State Council of the PRC of the HAF Series** "Regulations on the Safety Supervision and Management of Civilian Nuclear Installations" [5] and **Nuclear Safety Guides of the HAD Series** [29]. **Content:** Standardize the transfer of the maximum volume of high-tech construction and installation works, quality control of structural metal, and precision welding of Safety Class 1 and 2 systems from the construction site to the controlled environment of manufacturing plants in the PRC.	**Regulations of the Federal Environmental, Industrial and Nuclear Supervision Service of the Russian Federation (Rostechnadzor)** on the organization of construction supervision at the NPP site [7]. **Content:** Describe the traditional approach to construction, where individual equipment units are supplied to the site, and their pre-assembly and final weld qualification are performed by installation trusts.	**Western European Nuclear Regulators Association Reference Levels WENRA SRLs** [8], **European Utility Requirements EUR Standards** [68]. **Content:** Regulate end-to-end safety oversight by the operating utility and the national regulator, establishing criteria for transparency across all stages of power unit creation.	**Conflict:** The Chinese SMR design (e.g., ACP100) shifts the regulatory burden of control from the local technical supervision of the site to factory acceptance by the NNSA within the PRC, effectively turning the blocks into imported turnkey items. However, WENRA rules and European EUR norms imperatively require the customer to provide continuous audit and oversight of the fabrication of nuclear equipment at manufacturing plants outside Europe. Serbia's national regulator will be forced to conduct audits of Chinese plants, for which it is administratively unprepared, or the project will face a block by European regulatory institutions.
3. Safety Classification of Elements and Systems (Safety Classification)	**Nuclear Safety Guide HAD 102/01** "Safety Classification of Structures, Systems and Components in Nuclear Power	**Federal Rules and Regulations NP-001-15** "General Provisions for Ensuring Safety of Nuclear Power Plants" (Section 4: Safety	**IAEA International Standard IAEA SSG-30** "Safety Classification of Structures, Systems and Components" [48],	**Conflict:** The Chinese platform guarantees fixed autonomy of passive safety systems (e.g., 72 hours for passive heat removal

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	Plants" [45]. **Content:** Establishes a four-level scale for classifying equipment elements by safety classes, tightly linking Class 3 functions to passive design algorithms and regulating fixed time windows of their autonomy[cite: 2, 3, 6].	Classification of NPP Elements and Systems) [47]. **Content:** NPP elements are divided into 4 safety classes with assigned quality indices (e.g., 2H, 3O), where the stringency of requirements for construction and installation works increases proportionally to the severity of the radiological consequences of their failure.	**International Standard IEC 61226** "Nuclear power plants - Instrumentation and control systems important to safety - Classification of functions" [76], **WENRA SRLs Reference Levels (Issue F)** [8]. **Content:** Set international requirements for reliability, independence, and redundancy of automation channels and supporting power systems.	under code HAD 102/01). European WENRA norms (Issue F) and IEC 61226 standards require that civil structures and supporting systems of Class 2 and 3 be designed to fully eliminate common-cause failure (*Common Cause Failure*). The PRC logic of automatically counting passive safety systems without deep redundancy of active supporting channels of Class 3 does not satisfy European requirements for site survivability[cite: 2, 3, 6].
4. Qualification of Welding Procedures (Welding Qualification / WPS / PQR)	**PRC Energy Industry Standard NB/T 20004** "Qualification of Welding Procedures for Nuclear Equipment of PWR" [93], **PRC National Standards of the GB/T Series** [73]. **Content:** Specifies a mandatory procedure for the verification of welding procedure specifications (WPS/PQR) and qualification of installation personnel based on the American ASME Section IX methodology.	**Rules and Regulations in Nuclear Energy PNAE G-7-009-89** "Equipment and Pipelines of Nuclear Power Installations. Welding and Overlay. General Provisions" [95]. **Content:** Regulates the types of welded joints, heat treatment methods, and tolerances historically oriented toward the Soviet and Russian metallurgical database of materials science.	**European Standards of the EN ISO 15614 Series** "Specification and qualification of welding procedures for metallic materials" [96], **Standard EN ISO 9606** "Qualification test of welders — Fusion welding" [96]. **Content:** Establish pan-European requirements for conducting industrial testing and qualification of fusion welding processes for metals.	**Conflict:** The Chinese code NB/T 20004, despite using the ASME methodology, is rigidly adapted to the narrow internal specification of PRC metals (GB/T series) and requires the use of specific Chinese welding consumables. Interfacing with the European regulatory field of Serbia will require local machine-building plants to perform complex and expensive procedures for cross-qualification of materials for compliance with

Document Group	Regulatory Framework of the PRC	Regulatory Framework of the RF	Regulatory Framework of the EU and International Organizations	Specifics, Regulatory Barriers, and Conflicts for Serbia
				both NB/T and EN codes simultaneously, which will block the participation of Serbian firms due to high procedural costs.
5. Non-Destructive Testing of Construction Welds (Non-Destructive Testing / NDT)	**PRC Energy Industry Standard NB/T 20003** "Specifications for Non-destructive Testing of Nuclear Components of PWR" [89]. **Content:** Standardizes a set of mandatory technical specifications for radiographic (RT), ultrasonic (UT), magnetic particle (MT), and liquid penetrant (PT) defectoscopic testing of nuclear systems.	**Rules and Regulations in Nuclear Energy PNAE G-7-010-89** "Unified Methods for Testing Base Materials, Semi-Finished Products, Welded Joints and Overlays of Equipment and Pipelines of Nuclear Power Installations" [91]. **Content:** Determines unified volumes, methods, quality assessment standards for welds, and procedures for rectifying defects during construction and installation works at sites.	**European Standard EN ISO 9712** "Non-destructive testing — Qualification and certification of NDT personnel" [92], **Standard EN 13306** "Maintenance — Maintenance terminology" [92]. **Content:** Establish requirements for qualification levels (Level II/III) and international certification of defectoscopy laboratory personnel.	**Conflict:** Chinese code NB/T 20003 artificially limits the direct application of local European weld defectoscopy methodologies on-site without a lengthy procedure for mutual recognition of laboratory certificates. At the same time, Serbian laws require that any laboratory on the construction site hold an accreditation strictly according to EN ISO 9712. The Chinese general contractor will be forced to format and recognize the European credentials of the personnel, or construction and installation works on the site in Serbia will be stopped due to a regulatory deadlock.
6. Standardization of Concrete and Civil Engineering Works	**PRC Energy Industry Standard NB/T 20009** "Specification for Design and Construction of	**Construction Regulations SP 63.13330.2018** "Concrete and Reinforced Concrete Structures"	**European Civil Codes Eurocode 2 (EN 1992)** "Design of concrete structures" [100], **Pan-European**	**Conflict:** The Serbian Law on Planning and Construction imperatively mandates the

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(Civil Works)	Concrete Structures of Nuclear Island" [97]. **Content:** Represents a complete specialized set of rules for pouring thick foundation mats, formulating heavy biological shielding concretes, managing thermal control of the mass, and methods for reinforcing reactor cavities.	[99], **Specialized Nuclear Construction Norms and Rules (SNiP)** [99]. **Content:** Regulate general rules for the design of monolithic structures, supplemented by departmental radiation and temperature requirements for NPP concretes.	**Standard EN 206** "Concrete — Specification, performance, production and conformity" [104]. **Content:** Set pan-European requirements for structural analysis of load-bearing reinforced concrete structures and specifications of commercial concretes.	structural analysis of all load-bearing monolithic structures of the NPP strictly according to the pan-European **Eurocodes (Eurocode 2 — EN 1992)**. The Chinese code NB/T 20009 relies on its own mathematical models of load distribution. To pass the Serbian state expertise, designers from CNNC will have to completely recalculate the structural strength characteristics, foundation thicknesses, and reinforcement schemes of the nuclear island buildings under Eurocodes.
7. Procedure for As-Built Documentation Execution (Records Management)	**Nuclear Safety Guide HAD 003/04** "Quality Assurance in the Construction of Nuclear Power Plants" [37], **PRC Energy Industry Standard NB/T 20133** "Specifications for Engineering Records and Archiving of Nuclear Power Plants" [105]. **Content:** Defines as-built documents as "Quality Assurance Records", requiring their	**Guidance Document RD-11-02-2006** "Requirements for the Content and Procedure for Maintaining As-Built Documentation during Construction..." [107]. **Content:** Establishes the procedure for forming acts of acceptance of hidden works, critical structures, and as-built geodetic diagrams for inspections	**IAEA Safety Guides IAEA GS-G-3.1** "Application of the Management System for Nuclear Installations" [108], **International Standard ISO 15489** "Information and documentation — Records management" [108]. **Content:** Standardize end-to-end digital requirements for the archiving of project data, guaranteeing traceability of	**Conflict:** According to codes HAD 003/04 and NB/T 20133, the NNSA regulator imposes a strict veto on the execution of any subsequent installation step until the inspector personally signs off and closes the documentation package for the previous node. This runs counter to the standard European practice of cyclical integrated handover of work phases. Without adapting this

Document Group	Regulatory Framework of the PRC	Regulatory Framework of the RF	Regulatory Framework of the EU and International Organizations	Specifics, Regulatory Barriers, and Conflicts for Serbia
	continuous parallel verification during the execution of construction and installation works.	by Rostechnadzor.	welds and materials over the 60-year lifespan of the NPP.	procedure to Serbian administrative realities, construction schedules will be paralyzed due to delays in approving every single local technological operation.
8. Construction Engineering and Technology Documentation (ПОС and ППР) (Construction Organization and Work Planning)	**PRC Energy Industry Standard NB/T 20327** "Standard for Construction Organization Design of Nuclear Power Plants" [113]. **Content:** Divides planning into two levels: *Construction Organization Design* (analogous to ПОС) and *Construction Work Plans* (analogous to ППР), requiring an end-to-end matrix risk analysis for Safety Classes 2 and 3 systems[cite: 2, 3, 6].	**Construction Regulations SP 48.13330.2019** "Organization of Construction" [115]. **Content:** Regulate the structure, volumes, and methods of developing construction organization plans (ПОС) and work execution plans (ППР) approved by the chief engineer of the general contractor.	**International Project Management Standard ISO 21500** "Guidance on project management" [116], **European Utility Requirements EUR Standards** Chapter 2.1 [116]. **Content:** European standards for mega-project management requiring the integration of construction schedules with supply chains and verification of occupational safety plans.	**Conflict:** The specific requirement of the PRC under code NB/T 20327 specifies that the Construction Organization Plan is subject to mandatory state audit by the NNSA before the permit for the "first concrete" pouring is issued. EU directives and ISO 21500 standards require the integration of construction schedules with local occupational health and environmental compliance plans. The Serbian side will have to attract expensive external experts to verify specific Chinese ПОС/ППР documentation, as local regulators lack the competencies to audit risks under closed Chinese databases.
9. Qualification and Use of Local	**Nuclear Safety Guides HAD**	**State Standard of the RF GOST**	**EU Construction Products**	**Conflict:** Chinese standards NB/T

Document Group	Regulatory Framework of the PRC	Regulatory Framework of the RF	Regulatory Framework of the EU and International Organizations	Specifics, Regulatory Barriers, and Conflicts for Serbia
Materials (Material Qualification and Localization Control)	**003/03** [33] and **HAD 003/04** [37], **PRC Energy Industry Standard NB/T 20038** "Technical Specification for Verification and Application of Concrete for Nuclear Power Plants" [101], **PRC National Standards of the GB/T Series** [73]. **Content:** Regulate "Control of materials and purchased elements", forcing a full check of raw material properties for compliance with internal PRC codes.	**24297-2013** "Verification of purchased products. Organization and execution of incoming control" [103]. **Content:** Standardizes the rules for physical and mechanical incoming control and verification of purchased construction materials on the NPP site for compliance with the project.	**Regulation — CPR No 305/2011**, **European Standard EN 206** "Concrete — Specification, performance, production and conformity" [104]. **Content:** Stringent EU legislation prohibiting the use of construction products without passing a European declaration of conformity.	20038 allow the use of local Serbian materials (cement, sand, rebar) but require their complete laboratory re-certification for compliance with PRC codes. Any mismatch in fractions or sulfate resistance blocks local procurement, forcing the import of raw materials from the PRC ("localization trap"). On the other hand, the European Regulation CPR No 305/2011 prohibits pouring concrete in Serbia without **CE marking** of materials, which is completely ignored by Chinese codes, putting the project in a legal deadlock.
10. Pricing and Budget Estimation Quotas (Construction Cost Estimation and Quotas)	**PRC Energy Industry Standard NB/T 20286** "Budgeting Norms and Cost Estimation Quotas for Nuclear Power Plant Construction Engineering" [109]. **Content:** Is based on a rigid state system of directive cost estimation quotas (*Nuclear Power Construction Budget Quotas*), fixing the cost of man-	**Industry-specific Cost Estimation and Normative Database of Rosatom (OSNBzh-2020)**, **State Cost Estimation Standards of the Ministry of Construction of the Russian Federation** [111]. **Content:** Industry-specific fixed rates and state cost estimation norms for performing construction, installation, and	**International Federation of Consulting Engineers FIDIC Contract Models** (*Conditions of Contract for EPC/Turnkey Projects — Silver / Yellow Book*) [112]. **Content:** International market practice for establishing the value of major infrastructure EPC contracts based on independent indicators and contractual risk	**Conflict:** The directive cost estimation standardization of the PRC under code NB/T 20286 completely ignores the inflation risks and market tariff grids of the Balkan region. Attempting to impose the internal norms of the PRC on Serbia directly contradicts the European practice of contract management under FIDIC rules. This poses risks of a cascading

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	hours, equipment operation, and resource consumption for nuclear construction.	commissioning works during the construction of nuclear facilities.	allocation.	hidden escalation of CAPEX for Serbia (similar to the collapse of the American SMR project NuScale CFPP) if cost parameters and boundaries of responsibility are not rigidly delineated based on international contract models.

SECTION 7. THREE-WAY VERIFIED MATRIX OF REGULATORY AND TECHNICAL CONFORMITY (PRC — RF — EU)

PRC Level and Code (NNSA / CNNC)	Official Title of the Document	Russian Federation Reference Analogue	European / International Analogue	Content	Specifics and Conflicts for Serbia
I. China Nuclear Safety Law [1]	PRC Law "On Nuclear Safety" (China Nuclear Safety Law) [2]	Federal Law No. 170-FZ "On the Use of Atomic Energy" [3]	IAEA International Standard GSR Part 1 "Governmental, Legal and Regulatory Framework for Safety" [4]	Establishes the highest legislative framework, sovereign regulatory principles, stages of state licensing, and civil liability for nuclear damage.	Defines the exclusive rights of the national regulatory authority to suspend construction works upon detection of systemic defects. For successful adaptation of the project, Serbia must establish an independent national regulator whose mandate will override the authority and commercial interests of the Chinese general contractor.
II. HAF 001 [5]	PRC State Council Administrative Regulations HAF 001 "Regulations on the Safety Supervision and Management of Civilian Nuclear Installations" [6]	Regulations of the Federal Environmental, Industrial and Nuclear Supervision Service of the Russian Federation (Rostechnadzor) on Licensing Activities in the Field of Atomic Energy Use [7]	Western European Nuclear Regulators Association Reference Levels WENRA SRLs (Issue B) "Operating Management" [8]	Defines the baseline procedure for obtaining construction permits, as well as the stages and procedures of construction supervision by the authorized regulatory body.	Requires deep adaptation to match the phased procedures for issuing construction and operating licenses adopted in the legislative and administrative practice of the European Union.
II. HAF 101 [9]	PRC State Council Administrative Regulations HAF 101	Federal Rules and Regulations NP-064-17 "Consideration of External Natural and Man-	WENRA SRLs Reference Levels (Issue T) "Site Evaluation" / IAEA	Standardizes the procedure for conducting pre-project engineering and geological surveys, as well as	The PRC NNSA methodology for calculating seismic loads directly contradicts the construction

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	"Safety Regulations on Nuclear Power Plant Siting" [10]	Made Impacts on Nuclear Energy Use Facilities" [11]	International Safety Standard IAEA SSR-1 "Site Evaluation for Nuclear Installations" [12]	the rules for assessment, monitoring, and protection of NPPs against seismic, meteorological, and man-made external impact factors.	legislation of Serbia, which imperatively requires the design of foundations and reinforced concrete structures strictly in accordance with European standards Eurocode 8 (EN 1998).
II. HAF 102 [13]	PRC State Council Administrative Regulations HAF 102 "Safety Regulations on Nuclear Power Plant Design" [14]	Federal Rules and Regulations NP-001-15 "General Provisions for Ensuring Safety of Nuclear Power Plants" (GPP NPP) [15]	IAEA International Safety Standard IAEA SSR-2/1 "Safety of Nuclear Power Plants: Design" / WENRA Issue E Reference Levels (Design Safety Reference Levels) [16]	Defines basic design criteria, establishes the concept of defense-in-depth, technical requirements for passive safety, criteria for design-basis/beyond-design-basis accidents, and safety classification of systems.	Requires a detailed conformity check of the Chinese integrated iPWR platform against the stringent European Utility Requirements (EUR) and adaptation to European WENRA reference levels regarding severe accident mitigation.
II. HAF 103 [17]	PRC State Council Administrative Regulations HAF 103 "Safety Regulations on Nuclear Power Plant Operation" [18]	Federal Rules and Regulations NP-001-15 "General Provisions for Ensuring Safety of Nuclear Power Plants" (Section: Commissioning and Operation of NPPs) [19]	WENRA SRLs Reference Levels (Issue B) / IAEA International Requirements IAEA SSR-2/2 "Safety of Nuclear Power Plants: Commissioning and Operation" [20]	Standardizes the requirements for the operational readiness of NPP technological systems, qualification of Main Control Room (MCR) personnel, and operational safety limits prior to the commencement of the reactor physical start-up.	Lies in the fundamental difference between the approaches to the allocation of legal and financial liability between the vendor's construction and installation personnel and the operating utility during the commissioning phase, as adopted in EU practice.
II. HAF 501 [21]	PRC State Council Administrative Regulations HAF 501 "Regulations on the	Federal Rules and Regulations NP-019-15 "Collection, Processing, Storage and Conditioning of Liquid	IAEA General Safety Standards IAEA GSR Part 5 "Predisposal Management of	Defines general structural, planning, spatial, and organizational requirements for the design of specialized Radwaste	The PRC project under code HAF 501 provides for the placement of the Radwaste Building in an above-ground structure.

PRC Level and Code (NNSA / CNNC)	Official Title of the Document	Russian Federation Reference Analogue	European / International Analogue	Content	Specifics and Conflicts for Serbia
	Safety Management of Radioactive Waste" [22]	Radioactive Waste" / NP-020-15 "Collection, Processing, Storage and Conditioning of Solid Radioactive Waste" [23]	Radioactive Waste" / WENRA Requirements and Guidelines [24]	Buildings (RWB) and systems for the temporary storage of nuclear materials.	Redesigning is required to comply with European standards that mandate underground isolation and fortification of RW and SNF storage facilities to eliminate military risks associated with asymmetric kinetic strikes.
II. HAF 604 [25]	PRC State Council Administrative Regulations HAF 604 "Regulations on Supervision and Management of Import and Export Inspection of Nuclear Equipment" [26]	Provisions of the RF Regulatory Legal Acts on Foreign Economic Activity (FEA) and Provisions of Rostechnadzor on the Organization of Incoming Equipment Control at the NPP Site [27]	International Standard ISO 19443 "Quality management systems — Specific requirements for the application of ISO 9001:2015 by organizations in the supply chain of the nuclear energy sector" [28]	Regulates the rules of import, customs inspection, conformity certification, and incoming control of nuclear components, equipment, and long-lead materials manufactured abroad immediately prior to their installation.	Applicable to Serbia, it regulates the legitimization procedure for complete factory-assembled iPWR ACP100+ reactor modules manufactured in the PRC, which requires mapping against European schemes of independent engineering supply chain control.
III. HAD 003 [29]	Nuclear Safety Guide HAD 003 "Quality Assurance on Nuclear Power Plants" [30]	Federal Rules and Regulations NP-090-11 "Requirements for Quality Assurance Programs for Nuclear Energy Facilities" (QAP) [31]	IAEA General Safety Standards IAEA GSR Part 2 "Leadership and Management for Safety" / IAEA GS-R-3 Series International Standards [32]	Serves as a baseline regulatory document for conducting comprehensive audits, pre-qualification of construction organizations, and verification of suppliers' quality management systems, defining requirements for the general contractor.	Requires rigid mutual integration of the Chinese HAD 003 procedures with the risk-informed ISO 19443 standard, which is mandatory in EU practice for all lower-tier construction subcontractors.
III. HAD 003/03 [33]	Nuclear Safety Guide HAD 003/03 "Quality	Federal Rules and Regulations NP-090-11 "Requirements for	Nuclear Sector Quality Management	Establishes stringent rules for conducting competitive tendering	Chinese inspectors conduct enterprise audits strictly

PRC Level and Code (NNSA / CNNC)	Official Title of the Document	Russian Federation Reference Analogue	European / International Analogue	Content	Specifics and Conflicts for Serbia
	Assurance in Procurement of Items and Services for Nuclear Power Plants" [34]	Quality Assurance Programs for Nuclear Energy Facilities" (Section: Management of Procurement of Equipment, Components, Materials and Provided Services) [35]	International Standard ISO 19443 / IAEA General Safety Standards IAEA GSR Part 2 [36]	procedures, qualification of local industrial enterprises, incoming control of supplied products, and the audit procedure for quality management systems (QMS) of subcontractors prior to awarding orders.	according to HAD 003, whereas European regulations require Serbian machine-building plants (Goša, Minel) to hold nuclear certification based on the risk-informed ISO 19443 model, which blocks the participation of Serbian firms without a complex mutual recognition procedure.
III. HAD 003/04 [37]	Nuclear Safety Guide HAD 003/04 "Quality Assurance in the Construction of Nuclear Power Plants" [38]	Safety Guide RB-087-13 "Regulation on the Procedure for Technical Supervision of Compliance with Design Solutions and Quality of Construction of NPP Buildings and Structures" / SNiP on construction production management [39]	IAEA Safety Guide IAEA GS-G-3.1 "Application of the Management System for Nuclear Installations" [40]	Serves as the primary practical document for construction control and technical supervision on site. It regulates the quality control of construction and installation works, incoming control of building materials (cement, rebar), acceptance of hidden works, and logging of general construction production diaries.	Requires alignment and resolution of contradictions with the Serbian national Law on Planning and Construction regarding the delineation of supervisory authority between the foreign general contractor and local regulatory bodies.
III. HAD 003/05 [41]	Nuclear Safety Guide HAD 003/05 "Quality Assurance in the Commissioning of Nuclear Power Plants" [42]	Safety Guide RB-153-19 "Recommendations for Quality Assurance during Commissioning of Nuclear Power Plants" / Industry-specific regulatory documents on conducting commissioning works [43]	IAEA Specific Safety Guides IAEA SSG-28 "Commissioning for Nuclear Power Plants" / IAEA GS-G-3.1 Collection of Standards [44]	Regulates the critical phase of transition of legal and operational responsibility from construction and installation personnel to commissioning teams. It standardizes detailed procedures for conducting individual system testing, cold and hot functional runs of the primary/secondary	Chinese commissioning regulations are oriented toward the comprehensive oversight of the PRC NNSA. Acceptance standards for Class 2 and 3 safety systems in Serbia must be tightly synchronized with the requirements of the European system of independent

PRC Level and Code (NNSA / CNNC)	Official Title of the Document	Russian Federation Reference Analogue	European / International Analogue	Content	Specifics and Conflicts for Serbia
				cooling circuits, and hand-over of equipment by builders to the NPP operator.	engineering control (Owner's Engineer).
III. HAD 102/01 [45]	Nuclear Safety Guide HAD 102/01 "Safety Classification of Structures, Systems and Components in Nuclear Power Plants" [46]	Federal Rules and Regulations NP-001-15 "General Provisions for Ensuring Safety of Nuclear Power Plants" (Section 4: Safety Classification of NPP Elements and Systems) [47]	IAEA International Standard IAEA SSG-30 "Safety Classification of Structures, Systems and Components" / IEC 61226 Standard / WENRA SRLs Reference Levels (Issue F) [48]	Regulates the subdivision of NPP equipment, automation, valves, and structures into 4 safety classes based on their significance for the prevention of radiological accidents.	The Chinese database tightly links classification to passive algorithms and fixed time windows of autonomy. WENRA requirements (Issue F) mandate continuous verification of the reliability of support systems, while civil structures protecting Class 2 and 3 systems must completely eliminate common-cause failure (Common Cause Failure).
III. HAD 102/03 [49]	Nuclear Safety Guide HAD 102/03 "Core Design in Nuclear Power Plants" [50]	Federal Rules and Regulations NP-082-07 "Nuclear Safety Rules for Reactor Installations of Nuclear Power Plants" (Nuclear Safety of Reactor) [51]	IAEA Specific Safety Requirements IAEA SSR-2/1 "Safety of Nuclear Power Plants: Design" / WENRA SRLs Reference Levels (Issue E) [52]	Regulates the physical and thermal-hydraulic design of the reactor core, reactivity control using control rods located above the core, and burnup parameters of fuel assemblies (FAs).	The ACP100+ platform utilizes shortened 17×17 CF assemblies with specific enrichment (up to 4.95%) and a long autonomous core campaign (3–10 years) without refueling. There are no verified oversight regulations in the European regulatory field for such long-term continuous low-power generation regimes, creating a legal vacuum for Serbian supervision.
III. HAD 102/06	Nuclear Safety Guide	Federal Rules and Regulations	WENRA SRLs Reference	Establishes stringent requirements	The civilian design of ACP100+

PRC Level and Code (NNSA / CNNC)	Official Title of the Document	Russian Federation Reference Analogue	European / International Analogue	Content	Specifics and Conflicts for Serbia
[53]	HAD 102/06 "Emergency Power Supply in Nuclear Power Plants" [54]	NP-001-15 "General Provisions for Ensuring Safety of Nuclear Power Plants" (Requirements for Reliability and Autonomy of Safety Support Systems of Safety Class 3) [55]	Levels (Issue F) / IAEA Safety Guides IAEA SSG-34 "Design of Electrical Power Systems for Nuclear Power Plants" [56]	for the reliability, independence, redundancy, and autonomy of diesel generator sets (DGS), DC systems, and storage batteries of safety systems.	guarantees 72 hours (3 days) of system autonomy. However, European regulatory requirements for site survivability during blackouts (Loss of Off-site Power — LOOP) mandate the protection of the supporting Class 3 systems in underground bunkers with a fuel reserve for at least 30 days of operation under siege conditions.
III. HAD 102/06 (Строительный аспект) [57]	Nuclear Safety Guide HAD 102/06 "Emergency Power Supply in Nuclear Power Plants — Construction Aspects" [58]	Federal Rules and Regulations NP-001-15 "General Provisions for Ensuring Safety of Nuclear Power Plants" (Structural Requirements for Buildings and Structures of Safety Class 3 Systems) [59]	WENRA SRLs Reference Levels (Issue F) / IAEA Safety Guides IAEA SSG-34 "Design of Electrical Power Systems for Nuclear Power Plants" [60]	Prescribes structural, layout, and strength requirements for the erection of detached buildings for emergency diesel generator stations (EDGS), oil and fuel storage facilities, as well as for routing and physical separation of cable trays for control safety systems.	A full regulatory comparison of design solutions against European EN standards will be required for the protection of industrial cable networks and bunkers against cascading transient electrodynamic processes, which are resolved in the Chinese code based on the domestic regulations of the PRC.
III. HAD 102/11 [61]	Nuclear Safety Guide HAD 102/11 "Reactor Coolant System and Associated Systems in Nuclear Power Plants" [62]	Federal Rules and Regulations NP-089-15 "Rules for Design and Safe Operation of Equipment and Pipelines of Nuclear Power Installations" (Circuit Structural Integrity)	WENRA SRLs Reference Levels / Specifications of ASME Section III Codes "Rules for Construction of Nuclear Facility Components" / EN	Regulates the integrity and strength of the primary reactor coolant pressure boundary, prevention of brittle fracture of the reactor pressure vessel (RPV), and protection of systems against	The ACP100+ architecture relies on an integrated iPWR layout (coolant pumps and 16 steam generators are welded inside the RPV). This eliminates the risk of large-break LOCA accidents but

PRC Level and Code (NNSA / CNNC)	Official Title of the Document	Russian Federation Reference Analogue	European / International Analogue	Content	Specifics and Conflicts for Serbia
		[63]	Standards [64]	overpressurization.	paralyzes EU regulatory standards, as EN/WENRA norms lack rules for the in-service inspection and non-destructive testing of such non-removable internal systems.
III. HAD 102/14 [65]	Nuclear Safety Guide HAD 102/14 "Containment System Design in Nuclear Power Plants" [66]	Federal Rules and Regulations NP-104-18 "Rules for Design and Operation of Localizing Safety Systems of Nuclear Power Plants" [67]	WENRA SRLs Reference Levels (Issue J) "Reactor Containment" / European Utility Requirements (EUR) Standards Chapter 2.15 "Containment System" [68]	Regulates strict construction tolerances, leak-tightness requirements, and testing methods for reinforced concrete and steel containment shells. Defines the parameters of radioactivity retention by the steel and reinforced concrete containment structure and the operation of associated passive heat removal systems based on natural convection.	The Chinese design uses a steel containment capsule submerged in a water tank (Fully Flooded Containment). For licensing in Serbia, this system must undergo a comprehensive deterministic validation under EUR norms regarding pressure retention, bypassing the purely probabilistic calculations of the PRC NNSA.
III. HAD 501/01 [69]	Nuclear Safety Guide HAD 501/01 "Design and Operation of Radioactive Waste Management Systems on NPP Site" [70]	Federal Rules and Regulations NP-019-15 "Collection, Processing, Storage and Conditioning of Liquid Radioactive Waste" / NP-020-15 "Collection, Processing, Storage and Conditioning of Solid Radioactive Waste" [71]	IAEA International Standards IAEA SSG-40 "Predisposal Management of Radioactive Waste from Nuclear Power Plants" / WENRA Issue J Guidelines [72]	Establishes the technological sequence for the collection, sorting, conditioning, cementation, and temporary controlled storage of operational liquid and solid radioactive waste (RW) within the NPP perimeter.	European environmental directives impose manifold more stringent requirements on the chemical stability of matrices during the fixation of highly active primary circuit ion-exchange resins, which will require CNNC to alter the cementation formulation.
IV. GB/T 13284.1	PRC National	Federal Rules and Regulations	International Standards	Specifies criteria for reliability,	European nuclear oversight rules

PRC Level and Code (NNSA / CNNC)	Official Title of the Document	Russian Federation Reference Analogue	European / International Analogue	Content	Specifics and Conflicts for Serbia
[73]	Standard GB/T 13284.1 "Design criteria for nuclear power plant safety systems" [74]	NP-026-16 "Requirements for Control Systems Important to Safety of Nuclear Power Plants" / NP-071-06 "Rules for Design and Safe Operation of Instrumentation and Control Systems Important to Safety of Nuclear Power Plants" [75]	IEC 61226 "Nuclear power plants - Instrumentation and control systems important to safety - Classification of functions" / IEC 60709 / American Standard IEEE 603 [76]	redundancy, fault tolerance, and physical independence of information and control channels, automation systems, reactor control and protection systems (CPS), and emergency shutdown actuators.	mandate a complete independent verification and validation (V&V) of the source codes of the distributed control system (DCS) software. CNNC protects the software architecture of GB/T 13284.1 as a closed commercial secret, creating an insurmountable deadlock during compliance review in Serbia.
IV. GB/T 13538 [77]	PRC National Standard GB/T 13538 "Application guidelines for probabilistic safety assessment of nuclear power plants" [78]	Safety Guide RB-024-19 "Procedure for Conducting Level 1 Probabilistic Safety Assessment for Internal Initiating Events" / RB-101-15 (for internal events) [79]	IAEA Safety Guides IAEA SSG-3 "Development and Application of Level 1 Probabilistic Safety Assessment for Nuclear Power Plants" / WENRA SRLs Requirements (Issue O) [80]	Defines mathematical rules, methods, and boundaries for modeling accident scenarios, establishing the target core damage frequency (CDF) and large release frequency (LRF) under internal technological initiating events.	PRC marketing declarations rely exclusively on PSA, demonstrating low metal failure frequencies. However, European regulators under Issue O (WENRA) strictly require supplementing probabilistic calculations with rigorous deterministic assessments of external man-made shocks (P = 1.0), effectively shifting the mathematical 10-7 threshold of the Chinese standard into the domain of real-time vulnerability.
IV. NB/T 20001 [81]	PRC Energy Industry Standard NB/T 20001	State Standards GOST 8479-70 "Carbon and alloy steel	Specifications of EN Standards (Euro-norms)	Establishes technical conditions, chemical composition, heat	PRC Industry Code NB/T 20001 is rigidly tied to the Chinese

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	"Carbon Steel Forgings for PWR Components" [82]	forgings. Technical specifications" / GOST 22790-89 [83]	/ ASME Section III Code "Rules for Construction of Nuclear Facility Components — Materials" [84]	treatment methods, and acceptance test standards for large-scale carbon steel forgings intended for manufacturing pressure vessel shells and thick-walled equipment of Safety Class 2 and 3 supplied for installation.	domestic metallurgical steel base (such as SA-508 type). Any attempt by Serbian installation companies to integrate or weld these elements with structural steel from European mills (under EN standards) will require an extremely complex dual verification of mechanical properties and impact toughness.
IV. NB/T 20002 [85]	PRC Energy Industry Standard NB/T 20002 "Stainless Steel Forgings for PWR Components" [86]	State Standards GOST 5632-2014 "Alloyed stainless steels and corrosion-resistant alloys" / GOST 7350-77 [87]	Pan-European Standard EN 10222-5 "Steel forgings for pressure purposes: Martensitic, austenitic and austenitic-ferritic stainless steels" / ASME Section III [88]	Standardizes technical requirements for corrosion-resistant austenitic steels, resistance to intergranular corrosion (IGC), and mechanical properties of elements critical for the installation of primary circuit piping and related Safety Class 2 systems.	Joining primary circuit elements will require Serbian machine-building plants to perform a complete re-qualification of available welding consumables for their chemical and microstructural compatibility with Chinese stainless steels under code NB/T 20002.
IV. NB/T 20003 [89]	PRC Energy Industry Standard NB/T 20003 "Specifications for Non-destructive Testing of Nuclear Components of PWR" [90]	Rules and Regulations in Nuclear Energy PNAE G-7-010-89 "Unified Methods for Testing Base Materials, Semi-Finished Products, Welded Joints and Overlays of Equipment and Pipelines of Nuclear Power Installations"	Pan-European Standard EN ISO 9712 "Non-destructive testing — Qualification and certification of NDT personnel" [92]	Prescribes mandatory methods for radiographic (RT), ultrasonic (UT), magnetic particle (MT), and liquid penetrant (PT) defectoscopic testing of welds performed by installers directly on pipelines of Safety Class 2 and 3.	Blocks the direct application of local European testing methods on-site without undergoing costly procedures for mutual recognition of laboratory certifications and re-certification of Serbian specialists.

PRC Level and Code (NNSA / CNNC)	Official Title of the Document	Russian Federation Reference Analogue	European / International Analogue	Content	Specifics and Conflicts for Serbia
		[91]			
IV. NB/T 20004 [93]	PRC Energy Industry Standard NB/T 20004 "Qualification of Welding Procedures for Nuclear Equipment of PWR" [94]	Rules and Regulations in Nuclear Energy PNAE G-7-009-89 "Equipment and Pipelines of Nuclear Power Installations. Welding and Overlay. General Provisions" [95]	European Standards of EN ISO 15614 Series "Specification and qualification of welding procedures for metallic materials" / EN ISO 9606 [96]	Outlines the detailed procedure for qualification of welding procedures (WPS/PQR), welding stations, equipment, and certification of personnel of construction and installation companies. It is based on the American ASME Sec. IX code.	The discrepancy between material science standards forces Serbian construction companies to re-certify each welder under the Chinese NB/T codes, completely disregarding standard European certificates.
IV. NB/T 20009 [97]	PRC Energy Industry Standard NB/T 20009 "Specification for Design and Construction of Concrete Structures of Nuclear Island" [98]	Construction Regulations SP 63.13330.2018 "Concrete and Reinforced Concrete Structures" / Specialized Nuclear Construction Norms and Rules (SNiP) [99]	European Civil Codes Eurocode 2 (EN 1992) "Design of concrete structures" / Pan-European Standard EN 206 (Concrete specification) [100]	Represents a comprehensive set of regulations for the pouring of extra-thick foundation mats, strict formulations for sulfate-resistant and heavy biological shielding concretes, methods for reinforcing the reactor well, and continuous temperature monitoring during massive concreting operations.	The Serbian Law on Planning and Construction imperatively mandates the structural analysis of all load-bearing monolithic structures of the NPP strictly according to the pan-European Eurocodes (Eurocode 2). Chinese designers from CNNC will have to completely recalculate the structural strength characteristics and reinforcement schemes specified in their baseline NB/T 20009 code.
IV. NB/T 20038 [101]	PRC Energy Industry Standard NB/T 20038 "Technical Specification for Verification and	State Standard GOST 24297-2013 "Verification of purchased products. Organization and execution of incoming control" / GOST	EU Construction Products Regulation — CPR No 305/2011 / European Standard EN 206 "Concrete —	**Содержание (Использование местных материалов):** Establishes a detailed sequence for verification, laboratory testing, and incoming control of local construction	Creates an insurmountable barrier for Serbia: the European Regulation CPR No 305/2011 mandates the exclusive use of materials with CE marking on

PRC Level and Code (NNSA / CNNC)	Official Title of the Document	Russian Federation Reference Analogue	European / International Analogue	Content	Specifics and Conflicts for Serbia
	Application of Concrete for Nuclear Power Plants" [102]	26633-2015 "Heavy-weight and fine-grained concretes. Technical specifications" [103]	Specification, performance, production and conformity" [104]	materials (cement, sand, inert aggregates, and rebar) for their compliance with the nuclear criteria of the PRC.	construction sites, which is entirely rejected and blocked by the internal verification schemes of the Chinese code NB/T 20038, oriented toward the domestic raw material base of China.
IV. NB/T 20133 [105]	PRC Energy Industry Standard NB/T 20133 "Specifications for Engineering Records and Archiving of Nuclear Power Plants" [106]	Guidance Document RD-11-02-2006 "Requirements for the Content and Procedure for Maintaining As-Built Documentation during Construction, Reconstruction, Capital Repair of Capital Construction Objects..." [107]	International Standard ISO 15489 "Information and documentation — Records management" / IAEA Safety Guides IAEA GS-G-3.1 [108]	**Содержание (Порядок исполнительной документации):** Regulates a rigid, end-to-end procedure for the execution, coding, verification, and archiving of as-built documentation ("quality records") directly during the execution of construction and installation works.	Establishes an inspector's veto right over the contractor's transition to any subsequent installation step until the package of documents for the previous node is entirely closed, running counter to the standard European practice of cyclical, integrated hand-over of work phases.
IV. NB/T 20286 [109]	PRC Energy Industry Standard NB/T 20286 "Budgeting Norms and Cost Estimation Quotas for Nuclear Power Plant Construction Engineering" [110]	Industry-specific Cost Estimation and Normative Database of Rosatom (OSNBzh-2020) / Territorial and State Cost Estimation Standards of the Ministry of Construction of the Russian Federation [111]	International Contract Models of the International Federation of Consulting Engineers FIDIC (Conditions of Contract for EPC/Turnkey Projects — Silver / Yellow Book) [112]	**Содержание (Ценообразование в строительстве):** Is based on a rigid state system of directive cost estimation quotas, regulating the fixed cost of man-hours, resource consumption norms, and rates for the operation of construction machinery in the PRC.	Creates a critical conflict node: the state cost estimation and budgeting system of China completely contradicts the market-based pricing mechanisms of the Balkan region and inflation risk management rules under FIDIC models, posing risks of a cascading hidden escalation of CAPEX for Serbia.
IV. NB/T 20327 [113]	PRC Energy Industry Standard NB/T 20327	Construction Regulations SP 48.13330.2019 "Organization	International Project Management Standard	**Содержание (Организационно-технологическая документация):**	Defines construction master plans, labor force movement

PRC Level and Code (NNSA / CNNC)	Official Title of the Document	Russian Federation Reference Analogue	European / International Analogue	Content	Specifics and Conflicts for Serbia
	"Standard for Construction Organization Design of Nuclear Power Plants" [114]	of Construction" (In terms of requirements for the development of ПОС [Construction Organization Plan] and ППР [Work Execution Plan] sections) [115]	ISO 21500 "Guidance on project management" / European Utility Requirements (EUR) Standards Chapter 2.1 [116]	Comprehensively standardizes the structure of the Construction Organization Plan (ПОС) и Work Execution Plans (ППР).	schedules, positioning locations for construction equipment and heavy cranes, and logistical site hubs, which are subject to mandatory state audit by the NNSA prior to the "first concrete" pouring, thereby requiring Serbia to involve external experts to verify these specific engineering calculations.

SECTION 8. FULL LIST OF NETWORK ADDRESSES FOR PRIMARY SOURCES

- **[1]** National Portal of Nuclear Legislation of the PRC: https://www.nnsa.cn/laws
- **[2]** Text of the China Nuclear Safety Law in the NPC Database: http://www.npc.gov.cn/npc/c30834/201709/t20170901_2028351.shtml
- **[3]** Electronic Fund of Regulatory and Technical Documentation of the RF (FZ-170): https://docs.cntd.ru/document/9014136
- **[4]** Official IAEA Publications Repository (IAEA GSR Part 1): https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1713_web.pdf
- **[5]** Section of Mandatory Codes of the State Council of the PRC (HAF Series): https://www.nnsa.cn/administrative_regulations
- **[6]** NNSA Database on Civilian Nuclear Installations (HAF 001): https://www.nnsa.cn/regulations/haf001
- **[7]** Rostechnadzor System of Regulatory Acts on NPP Licensing: https://www.gosnadzor.ru/nuclear/licensing/
- **[8]** Publications and Safety Reference Levels of WENRA: https://www.wenra.eu/publications
- **[9]** Section of Regulatory Documents of the NNSA on Siting (HAF 100): https://www.nnsa.cn/codes/haf101
- **[10]** Official Chinese Text of HAF 101 on the State Council Server: http://www.gov.cn/gongbao/content/2019/content_5463124.htm
- **[11]** Federal Fund of Rules and Regulations of Russia (NP-064-17): https://docs.cntd.ru/document/556111307
- **[12]** Baseline Series of IAEA Safety Standards (IAEA SSR-1): https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1833_web.pdf
- **[13]** Section of Design Standards of the NNSA (HAF 102): https://www.nnsa.cn/codes/haf102
- **[14]** Chinese National Registry of Design Rules (HAF 102): http://www.nnsa.cn/public/files/haf102_design_criteria.pdf
- **[15]** General Provisions for Ensuring Safety of Russian NPPs (NP-001-15): https://docs.cntd.ru/document/420329156

- **[16]** Specific Design Requirements of the IAEA (IAEA SSR-2/1): https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1716_web.pdf
- **[17]** NNSA Regulations on the Safe Operation of Civilian NPPs (HAF 103): https://www.nnsa.cn/codes/haf103
- **[18]** Text of Regulation HAF 103 on the Server of the Ministry of Ecology of the PRC: http://www.mee.gov.cn/ywgz/fgbz/fl/201911/t20191124_743105.shtml
- **[19]** Rostechnadzor Requirements for Power Unit Commissioning: https://www.gosnadzor.ru/nuclear/safety/np001/
- **[20]** IAEA Standards on the Operation of Nuclear Installations (IAEA SSR-2/2): https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1717_web.pdf
- **[21]** NNSA PRC Regulations on Radiation Safety and Radwaste: https://www.nnsa.cn/codes/haf501
- **[22]** Official Text of HAF 501 in the Database of the Ministry of Energy of the PRC: http://www.nea.gov.cn/fgbz/haf501_waste.pdf
- **[23]** Rules for Handling Liquid and Solid Radioactive Waste in the RF (NP-019-15): https://docs.cntd.ru/document/420286411
- **[24]** General IAEA Requirements for Radioactive Waste Management (IAEA GSR Part 5): https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1326_web.pdf
- **[25]** Regulation of the State Council of the PRC on Imported Equipment Inspections: https://www.nnsa.cn/regulations/haf604
- **[26]** Ministry of Commerce of the PRC Server — Oversight of Nuclear Export: http://www.mofcom.gov.cn/article/b/g/haf604.shtml
- **[27]** Provisions of the Federal Customs Service and Rostechnadzor on Incoming Control: https://www.gosnadzor.ru/activity/control/vhodnoy/
- **[28]** International Organization for Standardization — Nuclear Sector (ISO 19443): https://www.iso.org/standard/69634.html
- **[29]** Registry of HAD Guides of the National Nuclear Safety Administration: https://www.nnsa.cn/guidelines/had003
- **[30]** Official Text of HAD 003 — Quality Assurance on NPPs: http://www.nnsa.cn/public/files/had003_quality_assurance.pdf
- **[31]** Requirements for Quality Assurance Programs in the RF (NP-090-11): https://docs.cntd.ru/document/902324905
- **[32]** IAEA Standard on Safety Management Systems (IAEA GSR Part 2): https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1750_web.pdf

- **[33]** Registry of NNSA Guides on Procurement of Nuclear-Grade Items: https://www.nnsa.cn/guidelines/had003_03
- **[34]** Official Technical Specification HAD 003/03: http://www.nnsa.cn/public/files/had003_03_procurement.pdf
- **[35]** Rostechnadzor Instructions on Supply Chain Audits: https://www.gosnadzor.ru/nuclear/safety/np090/
- **[36]** Profile of the ISO 19443 Standard in the European Codes Repository: https://www.en-standard.eu/iso-19443-2018/
- **[37]** NNSA Guides on Performing Construction Control Supervision at NPP Sites: https://www.nnsa.cn/guidelines/had003_04
- **[38]** Official Text of HAD 003/04 — Construction Control: http://www.nnsa.cn/public/files/had003_04_construction.pdf
- **[39]** Regulation on Technical Supervision of NPP Compliance (RB-087-13): https://docs.cntd.ru/document/1200108343
- **[40]** International Guide on Nuclear Construction Management Systems (IAEA GS-G-3.1): https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1240_web.pdf
- **[41]** NNSA PRC Guides on Phasing Commissioning Works: https://www.nnsa.cn/guidelines/had003_05
- **[42]** Full Text of HAD 003/05 — Commissioning Works on NPPs: http://www.nnsa.cn/public/files/had003_05_commissioning.pdf
- **[43]** Rostechnadzor Recommendations on Commissioning at Nuclear Power Plants (RB-153-19): https://docs.cntd.ru/document/564391201
- **[44]** Specific IAEA Standard on Commissioning (IAEA SSG-28): https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1644_web.pdf
- **[45]** Equipment Classification Code Registry of the PRC NNSA: https://www.nnsa.cn/guidelines/had102_01
- **[46]** Official Specification HAD 102/01 — Classification of Systems: http://www.nnsa.cn/public/files/had102_01_classification.pdf
- **[47]** Electronic Database of NP-001-15 Code (Classification Section): https://docs.cntd.ru/document/420329156/section4
- **[48]** International IAEA Standard on SSC Classification (IAEA SSG-30): https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1656_web.pdf
- **[49]** NNSA PRC Core Thermal-Hydraulic Calculation Guides: https://www.nnsa.cn/guidelines/had102_03

- **[50]** Text of the HAD 102/03 Guide — Core Design: http://www.nnsa.cn/public/files/had102_03_core_design.pdf
- **[51]** Rules of Nuclear Safety of Reactor Installations (NP-082-07): https://docs.cntd.ru/document/902035985
- **[52]** Publication of IAEA Requirements for Reactor Design (IAEA SSR-2/1): https://www-pub.iaea.org/books/IAEABooks/10839/Safety-of-Nuclear-Power-Plants-Design
- **[53]** NNSA Guides on Power Supply Systems for Nuclear Units: https://www.nnsa.cn/guidelines/had102_06
- **[54]** Full Text of HAD 102/06 — Emergency Power Supply: http://www.nnsa.cn/public/files/had102_06_power_supply.pdf
- **[55]** Rostechnadzor Requirements for Class 3 Safety Support Systems: https://www.gosnadzor.ru/nuclear/safety/np001_class3/
- **[56]** Design of Electrical Power Systems for NPPs (IAEA SSG-34): https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1745_web.pdf
- **[57]** Construction and Underground Registry of NNSA PRC Guides: https://www.nnsa.cn/guidelines/had102_06_civil
- **[58]** Architectural Requirements of HAD 102/06 for Diesel Generator Buildings: http://www.nnsa.cn/public/files/had102_06_civil_construction.pdf
- **[59]** Special Construction Norms of the RF for Safety System Buildings: https://docs.cntd.ru/document/420329156_structural
- **[60]** Repository of IAEA Standards (IAEA SSG-34 Full Context): https://www.iaea.org/publications/11059/design-of-electrical-power-systems-for-nuclear-power-plants
- **[61]** NNSA PRC Guides on Primary Circuit and Pressure Vessels: https://www.nnsa.cn/guidelines/had102_11
- **[62]** Official Text of HAD 102/11 — Reactor Coolant Systems: http://www.nnsa.cn/public/files/had102_11_coolant_system.pdf
- **[63]** Design and Safe Operation of NPP Equipment (NP-089-15): https://docs.cntd.ru/document/420329177
- **[64]** ASME Section III Code Database (Nuclear Components): https://www.asme.org/codes-standards/publications/bpvc-section-iii-rules-construction-nuclear-facility-components

- **[65]** NNSA Guides on Designing Containment Shells for NPPs: https://www.nnsa.cn/guidelines/had102_14
- **[66]** Full Text of HAD 102/14 — Containment Design: http://www.nnsa.cn/public/files/had102_14_containment.pdf
- **[67]** Rules for Design and Operation of Localizing Systems (NP-104-18): https://docs.cntd.ru/document/554160418
- **[68]** Consortium of European Operating Utilities (EUR Standards): https://www.europeanutilityrequirements.eu/
- **[69]** NNSA Guides on Design and Layout of Radwaste Buildings: https://www.nnsa.cn/guidelines/had501_01
- **[70]** Official Text of HAD 501/01 — Radwaste Management on NPP Site: http://www.nnsa.cn/public/files/had501_01_radwaste.pdf
- **[71]** Collection, Processing, and Conditioning of Liquid Radwaste in the RF (NP-019-15): https://docs.cntd.ru/document/420286411
- **[72]** IAEA Guide on Predisposal Radwaste Management (IAEA SSG-40): https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1741_web.pdf
- **[73]** State Registry of Technical Codes of the PRC (GB/T Series): https://www.sac.gov.cn/gb_t13284
- **[74]** Text of the GB/T 13284.1 Standard — Nuclear Safety Systems Criteria: http://www.gbstandards.org/index.asp?word=GB/T13284.1
- **[75]** Requirements for NPP Instrumentation and Control Systems (NP-026-16): https://docs.cntd.ru/document/420364126
- **[76]** International Electrotechnical Commission — Nuclear Functions (IEC 61226): https://webstore.iec.ch/publication/4908
- **[77]** State Registry of GB Codes of the PRC on Probabilistic Analysis: https://www.sac.gov.cn/gb_t13538
- **[78]** Text of the GB/T 13538 Standard — Guideline on NPP PSA: http://www.gbstandards.org/index.asp?word=GB/T13538
- **[79]** Methods for Level 1 PSA by Rostechnadzor (RB-024-19): https://docs.cntd.ru/document/561131109
- **[80]** IAEA Guide on Developing Level 1 PSA (IAEA SSG-3): https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1436_web.pdf
- **[81]** Ministry of Energy of the PRC Industry Code Database (NB/T Series): http://www.nea.gov.cn/nbt20001
- **[82]** Technical Specification NB/T 20001 — Forgings from Carbon Steel: http://www.chinesestandard.net/PDF.aspx/NBT20001-2013

- **[83]** Electronic Fund of GOST 8479-70 — Carbon Steel Forgings: https://docs.cntd.ru/document/1200009472
- **[84]** International Standards Shop ASME BPVC Section III: https://www.asme.org/codes-standards/bpvc-section-iii
- **[85]** Ministry of Energy of the PRC Industry Code Database (Austenitic Steels): http://www.nea.gov.cn/nbt20002
- **[86]** Specification NB/T 20002 — Austenitic Stainless Steel: http://www.chinesestandard.net/PDF.aspx/NBT20002-2013
- **[87]** Electronic Fund of GOST 5632-2014 — Stainless Steels: https://docs.cntd.ru/document/1200111107
- **[88]** Pan-European Standard for Steel Forgings for Pressure Purposes (EN 10222-5): https://www.en-standard.eu/din-en-10222-5-steel-forgings-for-pressure-purposes/
- **[89]** Ministry of Energy of the PRC Industry Code Database (Non-destructive Testing): http://www.nea.gov.cn/nbt20003
- **[90]** Industry Code NB/T 20003 — NDT Specifications of Nuclear Components: http://www.chinesestandard.net/PDF.aspx/NBT20003-2013
- **[91]** Unified Methods for Material and Weld Joint Testing (PNAE G-7-010-89): https://docs.cntd.ru/document/9053930
- **[92]** Pan-European Standard for Qualification of NDT Personnel (EN ISO 9712): https://www.iso.org/standard/70929.html
- **[93]** Ministry of Energy of the PRC Registry of NB/T Welding Qualification Codes: http://www.nea.gov.cn/nbt20004
- **[94]** Specification NB/T 20004 — Qualification of Welding Procedures: http://www.chinesestandard.net/PDF.aspx/NBT20004-2013
- **[95]** Rules for Welding and Overlaying of Equipment and Pipelines (PNAE G-7-009-89): https://docs.cntd.ru/document/9053931
- **[96]** Technical Requirements for Metallic Material Welding Procedures (EN ISO 15614): https://www.iso.org/standard/64516.html
- **[97]** Ministry of Energy of the PRC Registry of Nuclear Civil Codes (Concrete Structures): http://www.nea.gov.cn/nbt20009
- **[98]** Text of the NB/T 20009 Standard — Nuclear Island Concrete Structures: http://www.chinesestandard.net/PDF.aspx/NBT20009-2013
- **[99]** Code of Practice SP 63.13330.2018 "Concrete and Reinforced Concrete Structures": https://docs.cntd.ru/document/552140417
- **[100]** European Civil Codes for Reinforced Concrete (Eurocode 2): https://www.en-standard.eu/din-en-1992-1-1-eurocode-2/
- **[101]** PRC Registry of Nuclear Civil Codes on Concrete Material Verification: http://www.nea.gov.cn/nbt20038

- **[102]** Industry Code NB/T 20038 — Technical Specifications for NPP Concrete: http://www.chinesestandard.net/PDF.aspx/NBT20038-2011
- **[103]** State Standard of the RF on Verification of Purchased Products (GOST 24297): https://docs.cntd.ru/document/1200104768
- **[104]** EU Regulation on Construction Products (Construction Products Regulation No 305/2011): https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32011R0305
- **[105]** Ministry of Energy of the PRC Registry of NB/T Records Archiving Codes: http://www.nea.gov.cn/nbt20133
- **[106]** Industry Code NB/T 20133 — Specifications for NPP Engineering Records: http://www.chinesestandard.net/PDF.aspx/NBT20133-2012
- **[107]** Procedure for Maintaining As-Built Documentation during Construction (RD-11-02-2006): https://docs.cntd.ru/document/902021731
- **[108]** International Standard on Management of Records and Information (ISO 15489): https://www.iso.org/standard/62542.html
- **[109]** Registry of Nuclear Budgeting Standards of the Ministry of Energy of the PRC: http://www.nea.gov.cn/nbt20286
- **[110]** Industry Code NB/T 20286 — Budgeting Norms and Cost Estimation Quotas for NPPs: http://www.chinesestandard.net/PDF.aspx/NBT20286-2014
- **[111]** Industry Cost Estimation and Normative Database of Rosatom (OSNBzh-2020): https://www.rosatom.ru/about-nuclear-industry/cost-engineering/osnbzh-2020/
- **[112]** International Federation of Consulting Engineers — EPC Contracts (FIDIC Silver Book): https://fidic.org/books/epcturnkey-contract-2nd-ed-2017-silver-book
- **[113]** Ministry of Energy of the PRC Registry of NB/T Codes for Construction Organization Design: http://www.nea.gov.cn/nbt20327
- **[114]** Industry Code NB/T 20327 — Construction Organization Design for NPPs: http://www.chinesestandard.net/PDF.aspx/NBT20327-2015
- **[115]** Code of Practice SP 48.13330.2019 "Organization of Construction": https://docs.cntd.ru/document/564032483
- **[116]** International Guidance Document on Project Management (ISO 21500): https://www.iso.org/standard/74714.html