Terms of Reference (ToR)

for Feasibility Study on Treatment of Chemicals in the Nairit Chemical Plant, Yerevan, Armenia

1. Background

The Nairit Chemical Plant

The Nairit rubber plant The Nairit Chemical Plant (henceforth "the plant") was commissioned in 1936 and possessed technology for production of 20 types of polychloroprene (synthetic) rubber and latex based on both acetylene (natural gas based) and butadiene feedstocks. During the Soviet times, the plant accounted for a large share of global synthetic rubber production. Specifically, in 1987, the plant accounted for 15% of global supply.

In 1989, the plant operations were halted, which in the short to long term affected the viability of the plant's business model. The plant restarted operations at a smaller capacity in 1993. Several attempts were made to re-commission the plant to its full capacity, but most of these attempts failed given the underlying economics, i.e., the costs associated with importing the feedstock butadiene from Russia and the high cost of process energy given then increasing gas import costs. The plant produced some output in early 2000s. In 2006, the plant was sold to a UK-based company, Rhinoville Property Limited.

Several fires and explosions occurred at the Nairit Chemical plant with the first recorded in April of 1990, then in May of 1996, multiple fires and explosions in 2006 and 2009, with the most recent occurring on August 28, 2017. After the fire in 2017 the government initiated a study with the support of UN Environment and OCHA Joint Unit to design and propose chemical neutralization for existing chemicals at the plant. However, no conclusive recommendations were made on the neutralization/safe disposal of the chemicals on site.

Originally, the site was located in the industrial part of the city and away from residential areas but, with the passage of time, it has now been further absorbed into the expanding city limits. Consequently, the health, safety and environmental performance of the site has a direct impact on the health and welfare of Yerevan's residents.

World Bank support

In October 2024, The Government of Armenia has requested the World Bank support in the form of a $60M Investment Project Financing to address the problems posed by the site. The project's primary focus will be to address public health and environmental risks from the Nairit chemical plant, namely through: (i) neutralization of the hazardous chemicals/waste on site, including but not limited to chlorine gas cylinders, lacquer ethanol, acetylene, chlorinated organics and other priority chemicals; (ii) disassembly and decontamination of chemically contaminated and hazardous plant buildings and equipment; (iii) recovering, to the extent possible, the cleaned up metals for possible sale, especially given the high demand locally and regionally; and (iv) investigate occurrence and, as needed, prepare and implement remediation plans to manage residual risks and unlock the site for productive reuse. Overall, the project shall provide a pathway for enabling redevelopment of the site. The site remediation and redevelopment is expected leverage significant private sector intervention. Furthermore, this project is likely to contribute to creating direct jobs focused on technological interventions and in post remediation redevelopment and indirect jobs through expected construction.

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Grant Facility for Project Preparation

The Government of Armenia has received a World Bank grant to support project preparation (Grant Facility for Project Preparation / GFPP). The development objective of proposed grant is to support the preparation of an investment project aimed at reducing environmental and public health risks associated with legacy pollution at the former Nairit chemical plant site, and to enable safe, productive reuse of the area.

To prepare for the requested US$60 million investment operation, the World Bank is providing a US$1.5 million grant through the Grant Facility for Project Preparation (GFPP). The grant will finance key preparatory activities to ensure that remediation efforts are technically sound, environmentally sustainable, and socially inclusive. The envisaged activities are reflected in procurement plan. Amongst other preparation activities, such as assessment of soil and groundwater contamination and preparation of ESF instruments, the study subject to these ToR - 'Feasibility Study on Treatability and Neutralization of Chemicals in the Nairit Chemical Plant' - is financed through the GFPP grant.

Implementation arrangements

The project's and GFPP's implementing agency is the Ministry of Territorial Admin and Infra (MTAI), and specially the R2E2 (Renewable Resources Energy Efficiency) Fund under MTAI.

Hosted under the Ministry of Energy, The Armenia Renewable Resources and Energy Efficiency (R2E2) Fund, established in 2005 as a state non-profit entity acting as Armenia's dedicated vehicle for promoting renewable energy and energy efficiency through project implementation, financial instrument development, policy reform, and capacity building. The R2E2 Fund's mandate to facilitate the reduction of anthropogenic impacts on the environment and human health, attract private investment into clean energy, and support the enabling environment for sustainable land use.

The R2E2 Fund, experienced in the implementation of World Bank financed projects, will host the Project Implementation Unit (PIU). The PIU will be responsible for the management of the consultant under this ToR. The consultant will report to the PIU, specifically to the PIU's Project Manager, Civil Engineer, and Environmental Specialist.

2. Objectives

The primary objective of this feasibility study is to support preparation of the 'Nairit Environmental Remediation and Regeneration Project' by enhancing knowledge and data on the chemicals on-site, and identifying suitable options for treatment and remediation. Specifically, the consultant will therefore be required to:

- identify and classify the chemicals stored at the site, including their physical and chemical properties.
- evaluate potential treatment and neutralization technologies suitable for the identified chemicals.
- assess the technical and economic feasibility of the proposed treatment methods
- determine regulatory and safety compliance requirements, including hazardous waste handling, transportation, and disposal regulations.
- evaluate the potential environmental and human health risks associated with the identified neutralization methods

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- To provide recommendations for implementation, including cost estimates, timelines, and an environmental monitoring framework.

3. Detailed Task Description

Task 1: Inception report

The Consultant will mobilize during the Inception phase and start preparation works at the consultant's head office and in the field, familiarization with the project and all stakeholders and inquiry of ongoing projects and site activities. The following activities will be included in the Inception Phase:

i. Mobilization of staff; establishment of logistics; preparation of meetings with representatives of the MTAI-R2E2 and PIU, the Yerevan city government, Nairit site management, and key other stakeholders.

ii. Collection and review of other available and relevant information, studies, and assessments, evaluation and review in terms of completeness and gaps.

iii. Rough visual assessment of the site's present situation in terms of size and location, priority facilities and areas, surrounding neighborhoods; and other relevant aspects.

iv. Development of detailed methodology for the chemical inventory

The Inception Report will present the analysis of the available information and rough assessment of the Nairit site and on that basis present the detailed approach and workplan for the respective tasks and activities. The Inception report and updated workplan will be presented and discussed in an inception meeting with the PIU.

Task 2. Chemical Inventory and Characterization

The objective of this task is to establish sound data on types, quantities and status of chemicals stored on the site, as well as facilities and installations contaminated with chemical materials.

Historically, the site was one of the world's major producers of synthetic rubber. The factory's core output was chloroprene rubber (neoprene or polychloroprene), however according to available information more than 34 types of chemical products, including chloroprene-based latexes, were produced at the site. The most significant remaining hazards include:

- Lacquer ethanol: Considered the single greatest immediate threat. As of 2018, possibly over 1,200 tons were stored on site, with more than 1,000 tons still present as of 2025. It is highly flammable, and its combustion can release toxic gases including sulfur and acetylene compounds. Fires and explosions have already occurred at the plant due to this substance.
- Chlorinated organic waste and chlorine gas: Stored in degrading containers, posing risks of leakage and
- Chloroprene: residual chloroprene on site.
- Contaminated infrastructure facilities and pipes receive frequent treatment with nitrogen blanket to prevent fires and explosions.

A more detailed overview of types and quantities of chemicals on-site is provided in Annex 3 and Annex 4, though information is limited and unconfirmed. The status and quality of chemical materials

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is particularly uncertain. Therefore, a sound chemical inventory and characterization assessment is required for planning of treatment approaches.

The consultant will:

i. Conduct a comprehensive inventory of all chemicals stored at the plant, including solid, liquid, and gaseous substances. The inventory will include detailed assessment of how chemicals are contained and state of containment (vessels, tanks, pipelines, other equipment, warehouses, insulation, etc.). This activity will start with desk review of available documentation and comprehensive site visit/s.

ii. Prepare detailed sampling plan for determining presence, physical state, quantities and storage/containment conditions of present chemicals. The sampling plan will pay ample attention to safety precautions to access installation etc. for sampling, including preparations, opening and securing during sampling and closing of containments, and management of samples for delivery to testing laboratory. The inventory should include chemicals stored on site or still present in installation, but also materials such as asbestos and other hazardous substances that could be present on site.

iii. Present the detailed sampling plan to the PIU and other key relevant stakeholders for review and approval. After obtaining the necessary requisite permits, the consultant will perform the sampling campaign following country and local regulations and international best practice. The consultant shall outline the approach to the chemical inventory in the technical proposal, including estimates for number of samples and planned procedures for chemicals extraction and testing following country and international safety standards. These will be further refined in the sampling plan.

iv. Perform laboratory analysis to determine chemical composition, toxicity, reactivity, flammability, corrosiveness, and degradation properties, physical properties and other properties relevant for treatment options. The consultant will classify hazardous and non-hazardous substances based on relevant country and international regulations.

v. Develop a chemical inventory and characterization report, including detailed inventory, laboratory findings, and risk assessment of stored chemicals. In the report, the consultant shall also provide recommendations for temporary improvements of storage conditions, including containment measures, potential leakage risks, and incompatibility of stored chemicals.

Task 3. Treatment Options Assessment

Based on the results of Task 2 - Chemical Inventory and Characterization, the objective and results of this task is to present to the PIU available and suitable technical options for the treatment and neutralization of identified chemicals. The assessment shall include potential equipment and technologies for extraction, transport/storage, treatment and disposal of chemicals. Respective cost estimates shall be provided.

Specifically, under this task the consultant will:

i. Review existing, well-proven treatment and neutralization technologies applicable to the chemicals present and overall characteristics of the site. In identifying technologies, the consultant shall consider both on-site and off-site options, the latter possibly by bringing mobile treatment facilities. Options to be considered may include, but not limited to chemical

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neutralization, advanced oxidation processes, incineration, solidification/stabilization, bioremediation, encapsulation, and solvent recovery, giving special attention to specific conditions and options that are available or could be readily developed in Armenia.

ii. Assess the efficacy, operational feasibility, costs, potential constraints, and other critical elements that enable a thorough assessment and selection of potential technologies. Regulatory and environmental regulations will need to be carefully considered; the export of chemicals could be challenging in the context of Armenia. (Task 4).

iii. Develop a technology assessment report, laying out the advantages, disadvantages, and key considerations for each identified technology. The identified options have to be elaborated in a manner that enables the PIU and stakeholders to fully understand the implications of different available options. The assessment will be presented and discussed in a workshop with national government, local government and other critical stakeholders.

Task 4. Regulatory and Environmental Compliance

For identified potential treatment technologies, the consultant shall carry out an assessment of existing local, national and international regulations, carry out a compliance assessment against identified technologies, and develop a compliance report. Specifically, under this task the consultant shall:

i. Identify local, national, and applicable international regulations governing chemical treatment, hazardous waste management, and disposal in the context of chemicals and facilities present at Nairit site. Experience from similar projects in the country or region shall be taken into account.

ii. Assess potential environmental and health risks associated with current storage practices and proposed treatment options.

iii. Develop a compliance roadmap for obtaining necessary regulatory approvals and permits as required for identified treatment technology options.

iv. Engage with relevant environmental and health authorities to ensure adherence to legal and policy frameworks.

v. The compliance assessment and roadmap will be presented and discussed in a workshop with national government, local government and other critical stakeholders.

Task 5. Technical and Economic Analysis

For each identified potential treatment technology, the consultant will carry out a detailed technical and economic analysis. Under this task, the consultant will specifically:

i. Evaluate infrastructure, utilities, and operational requirements for each identified treatment method.

ii. Conduct a cost-benefit analysis for most promising treatment options per identified chemicals categories, including capital and operational expenses, lifecycle costs, and potential liabilities.

iii. Assess logistical considerations, including chemical transport, (temporary) storage facilities, and workforce training needs.

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iv. Consider risk factors such as chemical compatibility, process upsets, and unintended by-product formation.
v. Identify potential funding sources, incentives, or partnerships for implementing the recommended solutions, and assess the potential market value of available scrap metals.
vi. Providing recommendations for the selection of a suitable site or facility for the safe disposal or long-term storage of residues and waste resulting from the treatment.
vii. Develop a technical and economic feasibility report including technical assessment, infrastructure and operational requirements, cost estimates, logistical analysis, and regulatory and environmental compliance. The report shall outline selected high potential technologies.

3.5. Implementation Strategy

For selected high potential technologies, the consultant will prepare detailed treatment implementation plans for the safe extraction of chemicals and hazardous materials; the temporary storage or re-packaging of chemicals from containments and storage locations as may be required; transport as needed; treatment and operational procedures; and disposal. The implementation plan shall also include recommendations for the management of chemical containing equipment and facilities after removal of chemicals, including cleaning, securing, (partial) dissembling, and recommendations for cleanup or demolition of site facilities. The evaluation shall consider circular economy principles such as material recovery and reuse. As part of this task, the consultant will further:

i. Propose an integrated and phased approach for chemicals removal and stabilization with treatment and disposal
ii. Provide risk mitigation strategies, including contingency plans for accidental spills, leaks, and unexpected reactions.
iii. Develop an action plan with estimated timelines, budgetary requirements, and responsible entities.
iv. Identify potential technology providers, contractors, and research institutions that can support the implementation phase.
v. Develop a monitoring and evaluation framework to track progress, assess environmental impact, and ensure continuous compliance.
vi. Develop technical specifications and required qualifications for contracting.

The consultant will develop a final feasibility study report. This shall be a consolidated report including results and findings from all tasks as listed above, including chemical assessment, technology recommendations, cost estimates, implementations strategy, and environmental monitoring plan. The report will be presented in a workshop to key project stakeholders.

4. Qualifications and Experience Required

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The overall expertise required by the firm will need to include, but not be limited to:

- Environmental chemistry and hazardous waste management.
- Chemical engineering and treatment technologies.
- Regulatory compliance in chemical handling, hazardous waste treatment, and disposal.
- Environmental impact assessment and risk management.
- Project management and feasibility studies.
- Experience with similar industrial chemical management projects.

The consulting services shall be carried out by a dedicated team of experienced international and local professionals. It is expected that the Consultant will establish a strong core team of approximately 4-5 specialists with additional non-key experts as required. Particularly the team leader should have at least 15 years international experience in site remediation and hazardous waste management. Other technical key staff will need to be experienced in treatment of management of hazardous chemicals, and understanding of essential non-technical aspects like operational procedures, economic aspects, environmental and regulatory aspects, and others. The following key experts are foreseen:

Key expert 1: International hazarous waste specialist and team leader. At least 15 years of international experience in hazardous waste management, treatment of chemical materials, and industrial site remediation. The team leader shall have suitable understanding and expertise in technical and non-technical issues in industrial chemical management. Development of feasibility studies, team management, and substantial experience in engaging with government clients and sector relevant stakeholders is a requirement. The team leader shall have experience in the implementation of similar industrial chemical management projects, and work experience in the country/region or similar environments.

Key expert 2: National hazardous waste specialist and co-team leader. Hazardous waste management specialist with at least 10-15 years of experience in the sector. Strong experience with hazardous industrial site remediation projects in Armenia and the technical, financial and institutional setting of the sector. The co-team leader shall have experience in the implementation of similar industrial chemical management projects. Strong expertise on treatment technologies in the country as well as costing of technolgoies. Experience with the Armenian and Yerevan sector administration is preferable.

Key expert 3: International chemical engineer. At least 10-15 of years of international experience in feasibility study assessments and designing of extraction, transport/storage, treatment, and disposal of chemicals and industrial hazardous equipment based on the specific context of Nairit site. Experience in the implementation of similar industrial chemical management projects is required.

Key expert 4: National environmental and regulatory specialist. At least 5-10 years of experience with environmental impact assessments and suitability assessments for hazardous and chemical waste management. Experience in Armenia with site investigations and regulatory and environmental requirments for chemicals management is required.

Key expert 5: National financial specialist. At least 5-10 years of experience in the costing of hazardous waste management technologies and processes in Armenia.

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The Consultant shall provide any additional non-key short-term specialists providing complementary skills to the assignment as deemed necessary.

5. Duration, Deliverables and Payments

Deliverable	Deadline, after signing of contract	Payment
Inception report	4 weeks	10%
Chemical inventory and characterization report: Detailed inventory, laboratory findings, and risk assessment of stored chemicals.	8 weeks	20%
Treatment Feasibility Report: Analysis of viable treatment options, including pilot-scale test results if applicable.	10 weeks	20%
Technical and economic feasibility report including technical assessment, infrastructure and operational requirements, cost estimates, logistical analysis, and regulatory and environmental compliance.	12 weeks	20%
Final Feasibility Study Report: Consolidated report including implementation strategy, technology recommendations, cost estimates, risk assessment, and environmental monitoring plan	16 weeks	30%

The consultant shall provide the following reports and documentation:

- **Inception Report**: Outlining the methodology, work plan, and timeline.
- **Chemical Characterization Report**: Detailed inventory, laboratory findings, and risk assessment of stored chemicals.
- **Treatment Feasibility Report**: Analysis of viable treatment options, including pilot-scale test results if applicable.
- **Regulatory Compliance Report**: Summary of legal requirements, necessary permits, and compliance strategy.
- **Technical and Economic Feasibility Report**: Cost estimates, logistical analysis, and infrastructure assessments.
- **Final Feasibility Study Report**: Consolidated report including recommendations, cost estimates, risk assessment, implementation roadmap, and environmental monitoring plan.

6. Reporting and Coordination

The consultant shall report to the project's PIU, housed at the MTAI-R2E2. In addition to the specific deliverables, the consultant shall provide regular updates, including:

- Monthly progress reports detailing work completed, key findings, and any challenges encountered.
- Technical presentations to key stakeholders and regulatory bodies at key project milestones.
- Participation in stakeholder consultations, workshops, and site visits as required.
  Client's Input and Counterpart Personnel, if any ((a) Services, facilities and property to be made available to the Consultant by the Client: __ The Client will facilitate access to the Nairit

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site and relevant facilities, provide available project documentation and historical records, and facilitate coordination with relevant government agencies and stakeholders.

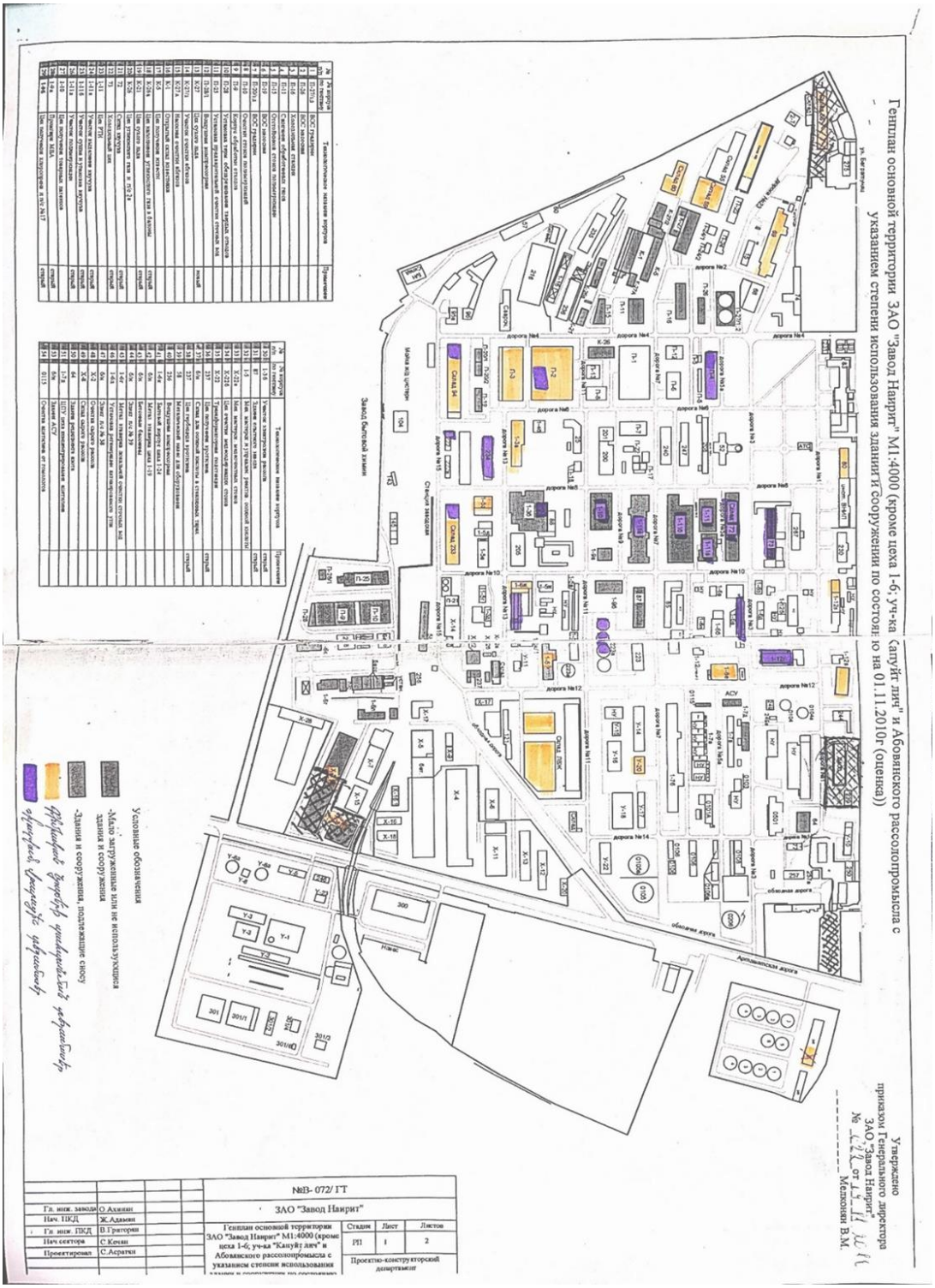
(b) Professional and support counterpart personnel to be assigned by the Client to the Consultant's team: A focal point will be assigned from the R2E2 to coordinate the assignment and facilitate communication with relevant authorities and stakeholders. Meetings under the assignment may be held at the meeting room of the R2E2.

7.

ANNEXES

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Annex 1. Nairit site map



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Annex 2. Site map 2



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Annex 3. Indicate list of materials.

	Materials	**Amount in kgs**
1	Combustible	1,437,817.6
2	Inorganic and hydrocarbon	943,310.8
3	Minerals	17,875.3
4	Potentially still usable (could be sold)	215,557.7
5	Aqueous solutions of chlorides	13,559,540
6	Hazardous	528,716
	Total:	16,702,817.40

Source: 2021 UNDP assessment

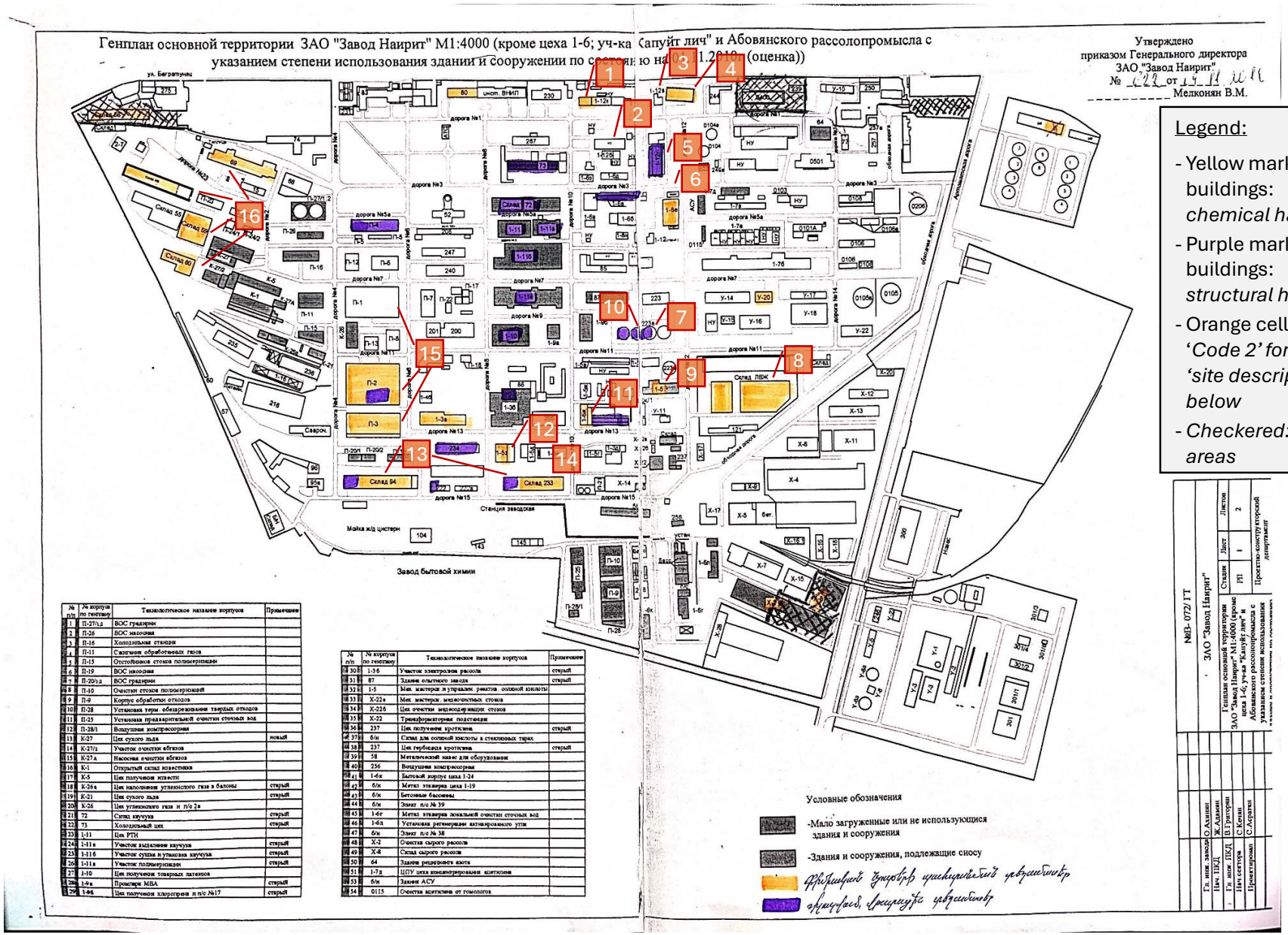
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Nairit Chemical Plant

World Bank site visit on March 6, 2025

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Nairit chemical plant: buildings map



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Nairit chemical plant: Descriptions of visited key buildings:

Code	Code 2	Purpose	Remarks	Priority	Photo
1-12a	1	Chloroprene production	- No storage of chemical substances - Residues on walls, pipes, etc. - Risk of fires and explosions - Ongoing treatment: nitrogen blanket (produced on-site) - Required treatment: washing - Office buildings just outside of compound, at risk - Treatment planned, awaiting budget and equipment from prime minister office	Very high	 IMG_3706
1-12d	2	Vinylacetylene production	- Raw material for Chloroprene production - No storage of chemical substances - Residues on walls, pipes, etc. - Risk of fires and explosions - Building however not marked yellow on map - Ongoing treatment: nitrogen blanket - Office buildings just outside of compound, at risk - Treatment planned, awaiting budget and equipment from prime minister office	Very high	 IMG_3708

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					 IMG_3710
12-b (left)	3	Purifier	- No mentioned chemical residues - Cleaned	Medium	

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1-12b right	4	Lacquer Ethanol storage	- 500 m^3 - Ongoing treatment: nitrogen blanket - Office buildings just outside of compound, at risk	Very high	 IMG_3715  IMG_3712

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1-12r	5	Facility	- No chemicals stored - No mentioned chemical residues - Structure unstable - Requires demolition	High/ med.	
1-12r (near by)	6	Pipes	-unstable - asbestos - possibly nitrogen blanket	Medium	

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223a	7	Watercoolers	- Structure unstable - Requires demolition	High/ medium	
	8	Chemicals storage	- Main storage facility for all combustible liquids - Pumped here from various facilities across compound - 700t Lacquer Ethanol - Stored Lacquer Ethanol up to 30 years old - Ongoing treatment: saline solution - Some of the stored LE was incinerated	Very high	 IMG_3735

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					 IMG_3736
1-5	9	Liquid waste incinerator	- Burning of of chlorine, organic waste, acetylene, lacquer ethanol - Chemical residues - 100t chlorinated organic waste still being stored here - Chlorinated organic waste has become solid - Incineration stopped in 2015	Very high	 IMG_3726  IMG_3727

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					 IMG_3732
223a	10		- View from incinerator towards water coolers 223a		

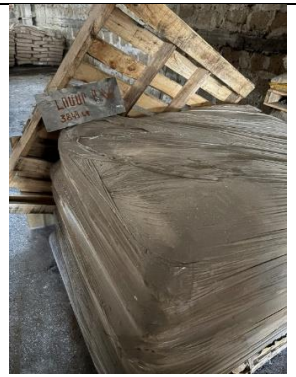
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1-6k	11	?	- Storage of 21t of ?	High	
1-5e	12	Facility	- Storage of 1000kg of chlorine - Treatment required	High	

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94 233= same	13	Storage facility for chemical raw materials	- Chemical raw materials were brought in by trains and offloaded and stored and distributed from here - Chemical residues and spillages - Now: storage of chemicals, in bags. Since 2010.	High	 IMG_2743  IMG_2745  IMG_3746

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					 IMG_3747  IMG_3749
-	14		- View from 94		 IMG_3751

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n1 n2, n3 = same	15	Rubber production	- n2 and n3: rubber and talc residues - n1: possibly clean - Area with highest potential for urban development (north end of compound)	High	 IMG_3752  IMG_3754
59 60 69		Carbide factory Lime kilns	- Chemical residues - Requires treatment and clean-up - Area with highest potential for urban development (north end of compound)	Very high	

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