Remediation of the uranium legacy sites in Central Asia requires a coordinated approach to ensure that remediation activities are addressed in a timely, coordinated, cost-effective and sustainable manner, as well as in accordance with relevant international conventions and agreements.

In accordance with the United Nations Sustainable Development Goals, coordinated efforts for remediation of uranium legacy sites in Central Asia aim to:

- Reduce the risks to people and the environment to tolerable and sustainable levels;
- Contribute to improved health and socioeconomic conditions in the affected areas; and
- Contribute to greater stability and security in the region.

The undersigned will support and contribute to a coordinated approach to remediation of uranium legacy sites in order to achieve safe and sustainable outcomes for the Central Asia region, subject to their respective regulations, rules, policies and procedures.

Date: 18 September 2017
Place: Vienna, Austria
ВЫПИСКА ИЗ ПРОТОКОЛА
ЗАСЕДАНИЯ КОМИССИИ
по экономическим вопросам при Экономическом совете СНГ

22 марта 2018 г. № 3 (251)

2. Об Информации о Стратегическом мастер-плане по рекультивации уранового наследия Центральной Азии

(Литвинов М.А., Шарипов А.А., Песков О.А., Асанжоева З.М., Кулеш А.М., Воробьев В.В.)

1. Принять к сведению Информацию о Стратегическом мастер-плане по рекультивации уранового наследия Центральной Азии (прилагается), подготовленную Государственной корпорацией по атомной энергии «Росатом» (Российская Федерация) совместно с Комиссией государств – участников СНГ по использованию атомной энергии в мирных целях при участии Исполнительного комитета СНГ.

2. Комиссии государств – участников СНГ по использованию атомной энергии в мирных целях совместно с заказчиком – координатором Межгосударственной целевой программы рекультивации территорий государств, подвергшихся воздействию уранодобывающих производств, учитывать положения Стратегического мастер-плана при планировании задач по рекультивации объектов уранового наследия Центральной Азии, а также в целях предотвращения дублирования мероприятий при реализации данных документов.

3. Направить представленную Информацию в правительства заинтересованных государств – участников СНГ для ее возможного использования профильными ведомствами.
2. On “Information on the Strategic Master Plan for Environmental Remediation of Uranium Legacy Sites in Central Asia”

(M.A. Litvinov, A.A. Sharifov, O.A. Peskov, Z.M. Asankozhoeva, A.M. Kuli-Zade, V.V. Vorobyev)

1. Note is taken of Information on the Strategic Master Plan for Environmental Remediation of Uranium Legacy Sites in Central Asia (attached), which was jointly prepared by the State Atomic Energy Corporation “Rosatom” (Russian Federation) and the Commission of CIS Member States on the Peaceful Use of Atomic Energy with the participation of the CIS Executive Committee.

2. The Commission of CIS Member States on the Peaceful Use of Atomic Energy, in collaboration with the client and coordinator of the Intergovernmental Target Programme on the Remediation of Territories Affected by Uranium Mining Industries, shall take into consideration the provisions of the Strategic Master Plan in the planning and carrying out of activities for the remediation of uranium legacy sites in Central Asia and with a view to avoiding duplication of activities in the implementation of the above mentioned documents.

3. The information submitted shall be transmitted to the governments of interested CIS Member States for possible use by the relevant agencies.

True copy: (signed)

[stamp]
Foreword

A core group of the Coordination Group on Uranium Legacy Sites (CGULS) has prepared this Strategic Master Plan for Environmental Remediation of Uranium Legacy Sites in Central Asia, which is being published by the International Atomic Energy Agency (IAEA), in its capacity as the Secretariat of CGULS.

The core group comprises representatives of the European Bank for Reconstruction and Development, the European Commission, Kyrgyzstan, the IAEA, the Russian Federation, Tajikistan and Uzbekistan.

Disclaimer

This Plan provides a framework of activities and schedules (with specific dates) that were established throughout 2017 and agreed by the core group of CGULS in September 2017.

The Plan is a living document and will be kept under continuous review and updated to reflect any substantive change in national priorities and plans for remediation of the uranium legacy sites.

This document has been produced with the financial assistance of the European Union. The views expressed herein can in no way be taken to reflect the official opinion of the European Union.
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<tbody>
<tr>
<td>BGR</td>
<td>Bundesanstalt für Geowissenschaften und Rohstoffe (Federal Institute for Geosciences and Natural Resources), Germany</td>
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<tr>
<td>CA</td>
<td>Central Asia</td>
</tr>
<tr>
<td>CGULS</td>
<td>Coordination Group for Uranium Legacy Sites</td>
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<tr>
<td>CIS</td>
<td>Commonwealth of Independent States</td>
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<tr>
<td>CISBOE</td>
<td>CIS Nuclear Commission Basic Organization for Education</td>
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<tr>
<td>CIS Nuclear Commission</td>
<td>Commission of the Member States of the CIS on the Use of Nuclear Energy for Peaceful Purposes</td>
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<tr>
<td>DTH</td>
<td>dry tailings heap</td>
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<tr>
<td>EBRD</td>
<td>European Bank for Reconstruction and Development</td>
</tr>
<tr>
<td>EC</td>
<td>European Commission</td>
</tr>
<tr>
<td>EIA</td>
<td>Environmental Impact Assessment</td>
</tr>
<tr>
<td>ENVIRONET</td>
<td>International Network for Environmental Management and Remediation of Radiologically Contaminated Sites</td>
</tr>
<tr>
<td>ENVSEC</td>
<td>Environment and Security Initiative</td>
</tr>
<tr>
<td>ERA</td>
<td>Environmental Remediation Account (of EBRD)</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>EuCAS</td>
<td>European and Central Asian Safety Network</td>
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<tr>
<td>EurAsEC</td>
<td>EurAsian Economic Community</td>
</tr>
<tr>
<td>FCCNRS</td>
<td>Federal Centre for Nuclear and Radiation Safety (of the Russian Federation) — a subsidiary company of ROSATOM</td>
</tr>
<tr>
<td>FS</td>
<td>feasibility study</td>
</tr>
<tr>
<td>FSD</td>
<td>Fondation Suisse de Déminage (Swiss Foundation for Mine Action)</td>
</tr>
<tr>
<td>GDP</td>
<td>gross domestic product</td>
</tr>
<tr>
<td>IAEA</td>
<td>International Atomic Energy Agency</td>
</tr>
<tr>
<td>INSC</td>
<td>Instrument for Nuclear Safety Cooperation (of the EU)</td>
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<tr>
<td>INTAS</td>
<td>International Association for the Promotion of Cooperation with Scientists from the Independent States of the former Soviet Union</td>
</tr>
<tr>
<td>IRSN</td>
<td>Institut de Radioprotection et de Sûreté Nucléaire (France)</td>
</tr>
<tr>
<td>ISL</td>
<td>in situ leaching</td>
</tr>
<tr>
<td>ISTC</td>
<td>International Science and Technology Center</td>
</tr>
<tr>
<td>KBMC</td>
<td>Karabaltinskiy Mining Plant</td>
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<tr>
<td>NATO</td>
<td>North Atlantic Treaty Organization</td>
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<tr>
<td>NRPA</td>
<td>Norwegian Radiation Protection Agency</td>
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<tr>
<td>NRSA</td>
<td>Nuclear and Radiation Safety Agency (Tajikistan)</td>
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<tr>
<td>OSCE</td>
<td>Organization for Security and Co-operation in Europe</td>
</tr>
<tr>
<td>OJSC</td>
<td>Open Joint Stock Company</td>
</tr>
<tr>
<td>PMU</td>
<td>Project Management Unit</td>
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<tr>
<td>RF</td>
<td>Russian Federation</td>
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<tr>
<td>ROSATOM-CICE&amp;T</td>
<td>Central Institute for Continuing Education and Training (of ROSATOM)</td>
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<tr>
<td>Abbreviation</td>
<td>Description</td>
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<td>--------------</td>
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<tr>
<td>RSLS</td>
<td>International Forum on the Regulatory Supervision of Legacy Sites</td>
</tr>
<tr>
<td>SCK-CEN</td>
<td>Studiecentrum voor Kernenergie – Centre d’Étude de l’Énergie Nucléaire (Belgium)</td>
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<tr>
<td>SDGs</td>
<td>Sustainable Development Goals</td>
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<tr>
<td>SMP</td>
<td>Strategic Master Plan</td>
</tr>
<tr>
<td>TACIS</td>
<td>Technical Assistance to the Commonwealth of Independent States</td>
</tr>
<tr>
<td>TAJREDMET</td>
<td>Owner/operator of uranium legacy site in Tajikistan</td>
</tr>
<tr>
<td>TC</td>
<td>Technical Cooperation (Department of IAEA)</td>
</tr>
<tr>
<td>TSF</td>
<td>tailings storage facility</td>
</tr>
<tr>
<td>TSO</td>
<td>technical support organization</td>
</tr>
<tr>
<td>UIMS Settings</td>
<td>Unified Information Management System (for Disaster and Crises Settings)</td>
</tr>
<tr>
<td>ULS</td>
<td>uranium legacy site(s)</td>
</tr>
<tr>
<td>UNDP</td>
<td>United Nations Development Programme</td>
</tr>
<tr>
<td>UNEP</td>
<td>United Nations Environment Programme</td>
</tr>
<tr>
<td>US</td>
<td>United States of America</td>
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<tr>
<td>WTF</td>
<td>water treatment facility</td>
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Executive Summary

The problem

Uranium mining and processing activities have been carried out in Central Asia since the mid-1940s, particularly in the mountainous areas above the Syr Darya river and the Ferghana valley, where the Kyrgyz Republic, the Republic of Kazakhstan, the Republic of Tajikistan and the Republic of Uzbekistan\(^1\) intersect.

Many of these activities ceased in the 1990s following the fall of the Soviet Union, leaving a legacy of abandoned uranium mining and milling sites, together with associated waste rock and low grade ore dumps, and tailings piles and ponds.

These uranium legacy sites\(^2\) (ULS) are located in a region where future development depends on the availability of water resources. The Syr Darya river is one of the principal rivers of the region, and the ethnically diverse Ferghana valley, home to 14 million people, is a fertile, 22 000 km\(^2\) agricultural area producing cotton, grains, tobacco, vegetables and fruit.

The region is also seismically active — prone to earthquakes and associated landslides. The mountain streams and rivers can be fast flowing and prone to flooding, particularly in the spring following snowmelt. This can potentially cause erosion and mudslides, which are becoming increasingly frequent as a result of climate change.

Few protective measures were in place prior to mine and mill closures, and little remediation has since been carried out at the disused facilities and waste sites. Where measures have been put in place, they generally do not meet current standards of good international practice. Mine shafts, tunnels and adits often remain open and accessible to local people and livestock. Waste rock and low grade ore dumps and tailings piles are often not or only poorly covered, and can be open to the elements. Rainwater and groundwater can enter the mine systems, dumps and piles and become contaminated, and may then be used for drinking water or irrigation.

These legacy facilities therefore pose serious risks to the environment and public health — including physical risks to people and animals, and radiological and toxicological risks from living in close proximity to the contaminated material remaining in the facilities.

The waste sites also pose both local and wider risks because of the possibility of structural failure, as a result of erosion or triggered by floods, earthquakes, landslides or mudslides. This could lead to widespread and transboundary dispersion of the radioactive and toxic material via the Syr Darya river system.

Left unremediated, the legacy sites will be an enduring source of elevated exposure to radioactive and toxic material for generation after generation, with implications for the human and animal health and well-being.

The release of radioactive and toxic legacy wastes into rivers is inevitable as long as the sites remain unremediated: it is not a question of ‘if’ but of ‘when’. Such releases may require lasting restrictions on the use of water downstream for drinking and irrigation, or its treatment to reduce the levels of radioactive or toxic material to tolerable levels. The imposition of such restrictions or treatment could have major implications for the health and economic well-being of the population in the Ferghana valley, where agriculture is a major contributor to GDP and to national food supplies. Waste releases may also affect stability and security in the region, if radioactive or toxic material were to be transported across national borders.

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\(^1\) Referred to as Kyrgyzstan, Kazakhstan, Tajikistan and Uzbekistan in the remainder of this document.

\(^2\) For the purposes of this Strategic Master Plan, a uranium legacy site is a site that fulfils the criteria below:

(a) Where uranium mining and/or processing has been carried out in the past but has ceased, or where waste from these operations has been disposed of;

(b) Where there is a need for remediation or continued monitoring to ensure the safety of the site; and

(c) Where the State has had to assume responsibility for the safety of the site in the absence of a private owner.
Need for coordinated approach to remediation

Faced with these serious and challenging inherited problems, Kyrgyzstan, Tajikistan and Uzbekistan generally do not have the means to remedy them in a sustainable manner in the foreseeable future. As has been formally recognized in the December 2013 resolution of the General Assembly of the United Nations[^3] and in numerous IAEA General Conference resolutions[^4], it is incumbent upon the international community to assist these countries in remediating the legacy sites and thereby avert this major threat to health, environment, stability and security.

Some support for remediation has been provided to the Central Asian Member States, but to date this has typically involved the efforts of a large number of actors, often operating independently. Such uncoordinated support, while well intentioned, is unlikely to have made best use of resources. With the notable exception of a World Bank project at Mailuu-Suu in Kyrgyzstan, the funds available were generally not sufficient to carry out substantial remediation work. This was recognized in 2012 with the establishment of the Coordination Group for Uranium Legacy Sites (CGULS), whose objectives include coordinating the actions of its members to maximize synergies and avoid duplication of effort.

Through the adoption of a Strategic Master Plan (SMP), the proposed pooling of funds through the Environmental Remediation Account (ERA) of the European Bank for Reconstruction and Development (EBRD), and the coordination of activities with those of the remediation programme of the Commonwealth of Independent States (CIS)[^5], should provide access to the larger sums needed to support actual remediation work. A core group of CGULS developed the Strategic Master Plan, will monitor its implementation and oversee its periodic updating.

A clear commitment by the Central Asian Member States and key partners to follow or adopt the principles and broad approach set out in the Strategic Master Plan is a prerequisite for its successful implementation and for gaining international support.

As part of the consultation process to develop the Plan, the three Member States were provided with the final draft in May 2017 for approval through their respective governmental processes. The Plan was also presented to the General Assembly of the Environmental Remediation Account (ERA) in July 2017, with a request to endorse it as the basis for ERA operations in Central Asia. Each of the three Member States, as well as the EBRD and EC, approved the final draft, which was officially endorsed at a signing ceremony in Vienna, Austria, on 18 September 2017 during the 61st IAEA General Conference.

The Plan was submitted to the Economic Council[^6] of the Commonwealth of Independent States (CIS) for consideration, and its formal endorsement was received on 22 March 2018.

Objectives and strategy

The strategic and integrated approach set out in the Plan is intended to provide confidence — in particular among potential donors — that remediation will be addressed in a timely, coordinated, cost-effective and sustainable manner, and in accordance with international conventions and agreements.

[^2]: IAEA General Conference Resolutions (2009-14): GC(53)/RES/10, para. 65; GC(54)/RES/7, para. 54; GC(55)/RES/9, para. 86; GC(56)/RES/9, para. 86; GC(57)/RES/9, para. 64; GC(58)/RES/10, para. 66; Ga(S5)/RES/9, para. 64; GC(56)/RES/9, para. 90.
[^3]: The Inter-State Targeted Programme on ‘Remediation of Member State Territories Affected by Uranium Mining Industries’ (hereafter referred to as the CIS Programme).
[^4]: The Economic Council comprises the deputy Head of Government of each State of the Commonwealth of Independent States.
It will enable the best use to be made of the limited resources available for remediation at national, regional and international levels by (a) aligning remediation activities with explicitly stated and commonly agreed sustainable long-term goals and (b) addressing the risks on a systematic and consistent basis across the whole region.

Strategic objectives:

- To remediate uranium legacy sites in Central Asia in accordance with international standards and good practice;
- To reduce the risks to people and the environment to tolerable and sustainable levels;
- To contribute to improved health and socioeconomic conditions and amenity in the affected areas;
- To contribute to greater stability and security in the region;
- To establish, through regional cooperation, a larger and more sustainable critical mass of knowledge and expertise within Central Asia for undertaking remediation and regulating its safety.

Guiding principles:

- Adopt a systematic, integrated and coherent approach to environmental remediation of ULS in Central Asia that contributes towards stability and sustainable development in the region and avoids potential duplication by different donors;
- Ensure, through cooperation, partnership and the involvement of interested parties, that the Strategic Master Plan and national strategies and plans for remediating ULS, and the practical implementation of the national strategies and plans, are aligned and remain so;
- Build on and fully exploit experience gained in the remediation of uranium legacy sites elsewhere, particularly in Central Asia;
- Ensure that the scale, nature and timing of remediation activities (e.g. including evaluation of remediation options and implementation of the preferred option) are compatible with the following:
  - National legislation and the requirements of regulatory authorities;
  - Capacities of the site owners and the regulatory authorities;
- Adopt a step-by-step approach to remediation in the region, focusing first on those uranium legacy sites judged to present the highest risks (with the aim of remediating these within the next 10 years) and, when remediation of these sites is complete, progressing to those judged to present a lower risk (with the aim of remediating these within the next 10 to 20 years);
- When developing remediation plans for ULS:
  - Give preference to approaches that address the risks of legacy sites as a whole and in an integrated manner;
  - Give consideration also to the remediation of objects\(^7\) presenting only a chemical or toxicological risk, where these are within or co-located with a ULS requiring remediation;
  - Give preference to the use of remediation options that minimize the need for long-term human intervention to maintain their efficacy.

\(^7\) ‘Object’ is the term used in this document to denote something located on a ULS that presents a risk requiring remediation (e.g. an open mine shaft or adit, a waste dump, a tailings pile, contaminated land, contaminated water, facilities/installations involved in the processing of uranium ore).
Scope

The Strategic Master Plan has been developed in the context of, and aligned with, relevant international agreements and strategies: specifically the United Nations Sustainable Development Goals (SDGs) — including underlying principles relating to: equity in meeting the development and environmental needs of present and future generations; the involvement of concerned citizens; and environmental impact assessment — and the principles established and reaffirmed in successive High Level Fora on Aid Effectiveness — relating to ownership, alignment, results, partnerships and mutual accountability.

The Plan provides a framework for implementing the strategy and achieving its objectives. It comprises the following four main elements:

1. Ranking of the sites (and/or objects within them) in terms of risk and/or priority for remediation;

2. Establishing a systematic, coherent, cost-effective and fully integrated approach for evaluating the need for, and nature of, the remediation that should be applied. Such an evaluation is to be undertaken prior to decisions on funding the remediation of one or other site, so that its outcomes can inform those decisions;

3. A programme setting out the main tasks or activities to be undertaken, along with associated schedules, milestones (road map) and costs. The programme includes two distinct types of activity:
   a. Activities relating specifically to the remediation of legacy sites;
   b. Activities relating to supporting measures, focusing on further capacity-building and enhancing cooperation in the region;

4. Institutional and organizational arrangements and funding for implementing the Plan.

The following are the sites covered by the Strategic Master Plan:

- Kyrgyzstan: Kadji-Say, Kara Balta, Mailuu-Suu, Min-Kush and Shekaftar;
- Tajikistan: Adrasman, Buston (formerly Chkalovsk — including Degmay, Gafurov, Karta 1–9 and Khujand) and Istiklol (formerly Taboshar);
- Uzbekistan: Charkesar and Yangiabad.

Sites that contain legacies from uranium extraction and processing but that remain in operation are not covered by the Plan — provision (financial and otherwise) should have been made for their remediation prior to or on the cessation of operations as part of their licensing arrangements.

The Plan takes as its starting point and builds on relevant activities already carried out by the three countries themselves, as well as those undertaken with support from various organizations. This includes evaluations of the risks and proposed remediation options and remediation works that have been undertaken, are under way, or are scheduled.

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8 The Sustainable Development Goals are contained in General Assembly resolution A/RES/70/1 of 25 September 2015.

9 Notably the Busan Partnership for Effective Development Co-operation, Fourth High Level Forum on Aid Effectiveness, Busan, Republic of Korea, 29 November–1 December 2011.

10 The legal status of the Kara Balta plant and its tailings piles is being clarified; a decision will then be taken (foreseen in mid-2018) on whether its remediation should be covered by the Plan.

11 In addition, two relatively small legacy sites at Kyzyl-Djar and Tuya-Moyun are included in the Plan; but these sites have low priority and will only be addressed when the sites presenting higher risks have been remediated (probably not before 2028). The costs of remediation of these two sites have not been included in the estimates below because they are likely to be small in comparison.
Implementation cost and schedule

A summary of the cost of relevant work that has already been carried out or is under way is included in the Plan, as well as estimates of costs for the further work needed.

Systematic and comprehensive evaluations of the risks and remediation options have been carried out at six sites (Min-Kush, Kadji-Say, Shekaftar, Istiklol (Yellow Hill\textsuperscript{12} and tailings ponds 1–4), Charkesar and Yangiabad) and are under way at three more (the whole of Mailuu-Suu, Istiklol (excluding Yellow Hill and tailings ponds 1–4) and Degmay). The costs of these studies amounted to about €12 million, of which around 80% has been provided from the European Union’s Instrument for Nuclear Safety Cooperation (INSC) and the remainder from the CIS Programme.

Remediation work has been carried out and is already under way at some sites. About €11 million of remediation work was carried out at Mailuu-Suu with funding from the World Bank; around €25 million has been committed by the CIS Programme for remediation of tailings at Min-Kush and Kadji-Say; and €2.5 million has been committed by the INSC programme for a treatment facility for mine waters at Istiklol.

Remediation projects at four sites — Min-Kush (for objects other than tailings), Shekaftar, Charkesar and Yangiabad — are ready for implementation, subject to the availability of funds. Remediation projects at two further sites, Istiklol and Degmay, will be ready in 2018, subject to available funding, and a proposed remediation option for the entire Mailuu-Suu site is expected to be ready in 2019. Based on preliminary indications for these last three sites, the total cost of remediating the seven sites is estimated at around €100 million.

Systematic and comprehensive evaluations of the risks and remediation options have yet to be made for Kara Balta, Buston (Karta 1–9 and Khujand) and Adrasman, and are estimated to cost around €5 million. When the evaluations have been carried out, a complete portfolio of ‘implementation ready’ remediation projects for all the sites will be available. Preliminary estimates suggest that the remediation work needed at these five sites/objects could amount to around €40 million.

Several activities dedicated specifically to capacity-building and regional cooperation have already received support amounting to over €5 million in total. Further support will also be essential to achieve timely, effective and sustainable remediation of the various sites/objects, including provisions for long-term stewardship. The Plan includes an indication of the timing and duration of a number of activities to support capacity-building and regional cooperation, along with milestones for decisions. The total cost of these further support activities is estimated to be around €10 million.

The above costs are the best estimates currently available, and are associated with varying levels of uncertainty depending on how they were derived. They will be further refined as more detailed technical studies become available and the market has had an opportunity to respond. The cost of project risks and escalation\textsuperscript{13} may well exceed the contingencies already included in the estimates.

\textsuperscript{12} A waste dump comprising low grade uranium ores and barren ore residues following in situ leaching, commonly referred to as ‘Yellow Hill.’

\textsuperscript{13} The term ‘escalation’ (rather than ‘inflation’) is used for increases over time in specific cost items, such as labour and materials, as it is more appropriate in this context.
Required funding and mechanism

The overall costs of remediating the uranium legacy sites included in the Plan, together with supporting activities, are estimated at around €210 million. By far the majority of these costs (around €180 million) are for actual remediation work, around €17 million for comprehensive evaluations of the risks and remediation options at the various sites, and around €15 million to support capacity-building and other activities that are considered essential for ensuring the success of the remediation activities.

A total of some €56 million has already been committed towards remediation activities: €12 million for systematic and comprehensive evaluations of the risks and remediation options, around €39 million for actual remediation and around €5 million for capacity-building. A further €12 million is available in the CIS Programme (provisionally allocated for the remediation of Yellow Hill and tailings 1–4 at Istiklol) and ERA currently holds an initial contribution of €16.45 million from the European Commission. This leaves a shortfall of about €130 million that will need to be found from other sources in order to achieve the foreseen remediation.

A high level donors’ or pledging conference is envisaged for 2018, at which further contributions to ERA will be sought. The size of these contributions will determine the rate at which the remediation identified in the Plan can be undertaken.

Coordination and control of projects

Institutional and organizational arrangements have been established to ensure the effective implementation of the Plan and coordination between interested parties. In its capacity as the Secretariat of CGULS, the IAEA, on behalf of and in consultation with the core group, will:

- Promote the adoption of a systematic, integrated and coherent approach to environmental remediation in Central Asia;
- Advise donors to make the provision of third-party support and funding for remediation conditional upon the existence of a systematic and comprehensive evaluation of the risks presented by a legacy site (or an object within it) and options for its remediation;
- Monitor the implementation of the Strategic Master Plan and update it as necessary;
- Facilitate the establishment of coordination between the EBRD’s ERA and the CIS Programme in the funding and implementation of environmental remediation;
- Encourage donors to ensure that the scale, nature and timing of remediation activities are compatible with the capacities of the site owners and the regulatory authorities;
- Encourage donors to support, where necessary, national regulatory authorities in carrying out reviews and approving the safety and environmental acceptability of any proposed remediation project;
- Facilitate the sharing of information between all parties.

Projects will be implemented in accordance with the administrative, financial and operational procedures of the donors (e.g. ERA and the CIS Programme). Framework Agreements, which have the status of international treaties and provide the legal basis for ERA operations, are in place between the EBRD and Kyrgyzstan, Tajikistan and Uzbekistan. Project Management Units (PMUs) are being established for the purposes of design, procurement and management of remediation projects funded by ERA. The CIS Programme is already fully operational.
1. Introduction and background
1. Introduction and background

1.1 Scope and purpose

This document sets out a Strategic Master Plan (SMP) for the environmental remediation of uranium legacy sites\(^{14}\) (ULS) in Central Asia, in particular Kyrgyzstan, Tajikistan, Uzbekistan and Kazakhstan,\(^{15}\) although more detailed development of the Plan is needed for Uzbekistan, and the Plan for Kazakhstan is still at a formative stage.

The Plan has been developed on behalf of the Central Asian Member States by a core group of the Coordination Group for Uranium Legacy Sites (CGULS),\(^{16}\) building on the Technical Baseline Document [1]. The core group comprises representatives of the European Bank for Reconstruction and Development (EBRD), the European Commission (EC), the IAEA, Kyrgyzstan, the Russian Federation and Tajikistan. In addition to developing the Strategic Master Plan, the core group will monitor its implementation and update it periodically.

A clear commitment by the Central Asian Member States and key partners to follow and/or adopt the principles and broad approach set out in the Plan is a prerequisite for its successful implementation and for gaining international support. As part of the consultation process to develop the Plan, the three Member States were provided with the final draft of the Plan in May 2017 for approval through their respective governmental processes. The Plan was also presented to the General Assembly of the Environmental Remediation Account (ERA) in July 2017, with a request to endorse it as the basis for ERA operations in Central Asia.

Each of the three Member States, as well as the EBRD and the EC, approved the final draft of the Plan, which was officially endorsed at a signing ceremony in Vienna, Austria, on 18 September 2017 during the 61st IAEA General Conference. The Plan was then submitted to the Economic Council\(^{17}\) of the Commonwealth of Independent States (CIS) for consideration, with formal endorsement received on 22 March 2018.

National plans and strategies for the remediation of ULS in Kyrgyzstan, Tajikistan and Uzbekistan will, where necessary, be updated to be consistent with this Plan. Likewise, the Plan will be kept under continuous review and updated to reflect any substantive change in national priorities and plans for the remediation of ULS.

The Plan is intended to provide a fully integrated, coherent, systematic, transparent and effective approach to the environmental remediation of ULS in Central Asia that makes best use of available resources. As such, it will provide the affected Member States and the potential donors with the confidence that the risks and problems posed by ULS in Central Asia will be addressed in a timely, coordinated, cost-effective and sustainable manner.

The Plan has been developed in the context of, and has been aligned with, relevant international agreements and strategies. It specifically takes account of the United Nations Sustainable Development Goals [2], which build on the United Nations Millennium Development Goals.

\(^{14}\) For the purposes of this Strategic Master Plan, a uranium legacy site is a site that fulfils the criteria below:

- (a) Where uranium mining and/or processing has been carried out in the past but has ceased, or where waste from these operations has been disposed of;
- (b) Where there is a need for remediation or continued monitoring to ensure the safety of the site;
- (c) Where the State has had to assume responsibility for the safety of the site in the absence of a private owner.

\(^{15}\) These are the official short names for the Kyrgyz Republic, the Republic of Tajikistan, the Republic of Uzbekistan and the Republic of Kazakhstan, and will be used in the remainder of this document.

\(^{16}\) Eligible members of CGULS are IAEA Member States affected by ULS in Central Asia, and other Member States or international organizations interested in contributing to its objectives and scope. The following attended the annual meeting of CGULS in 2016: Kazakhstan, Kyrgyzstan, Tajikistan, Ukraine, Uzbekistan, the Russian Federation, Norway, the IAEA, ROSATOM, the European Commission, the European Bank for Reconstruction and Development, the World Bank, the United Nations Development Programme, and the Swiss Foundation for Mine Action.

\(^{17}\) The Economic Council comprises the deputy Head of Government of each State within the CIS.
The Sustainable Development Goals were developed following the 20-year anniversary conference of the United Nations Conference on Environment and Development [3], which first linked environmental, economic and social development, and introduced several fundamental principles that include the following:

- The right to development must be fulfilled so as to equitably meet the developmental and environmental needs of present and future generations;

- Environmental issues are best handled with participation of all concerned citizens, at the relevant level;

- Environmental impact assessments, as a national instrument, shall be undertaken for proposed activities that are likely to have a significant adverse impact on the environment, and are subject to a decision of a competent national authority.

The Strategic Master Plan also acknowledges the principles established and reaffirmed by successive High Level Fora on Aid Effectiveness [4]. These principles include the following:

Ownership (partnerships for development can only succeed if they are led by beneficiary countries, implementing approaches that are tailored to their specific situations and needs);

Focus on results (investments and efforts must have a lasting impact on poverty, inequality, sustainable development and enhancing beneficiary countries’ capacities, aligned with priorities and policies set out by the beneficiary countries themselves);

Inclusive partnerships (openness, trust, and mutual respect and learning lie at the core of effective partnerships);

Transparency and mutual accountability (transparent practices form the basis for enhanced accountability, and donors and partners are both mutually accountable and accountable to intended beneficiaries).

The Strategic Master Plan comprises two main elements: the Strategy to be adopted and followed in remediating the uranium legacy sites in Central Asia, and the Master Plan for its implementation. Both are set out in the following sections and are supported, where necessary, by appendices.

Appendix A contains more detailed information, generally of an explanatory nature, to enable the reader to appreciate more fully the nature and extent of the risks presented by ULS in Central Asia and the pressing need for their remediation. Appendix B summarizes the outcomes of studies that have been made of the risks presented by each legacy site, and options, including costs, for their remediation. Appendix C summarizes good international practice related to the conduct of such studies.

1.2 Uranium legacy sites and their risks

The uranium legacy sites covered by the Strategic Master Plan are listed in Table 1 for Kyrgyzstan, Tajikistan and Uzbekistan, and their locations are shown in Figure 1. They include all the sites in each Member State at which significant activities related to the extraction and/or processing of uranium took place and have now ceased.

Sites that contain legacies from the extraction or processing of uranium but that remain in operation are not covered by this Plan, nor included in Table 1; provision (financial and otherwise) should have been made for their remediation prior to or on the cessation of operations as part of their licensing arrangements.

Uranium exploration may have taken place at other locations, and waste material containing uranium and other radioactive or toxic material may remain in situ. Such locations will be
Uranium mining and processing activities have been carried out in Central Asia since the mid-1940s, often centred on the mountainous areas above the valley of the Syr Darya river, where the territories of Kyrgyzstan, Uzbekistan, Tajikistan and Kazakhstan intersect (see Figure 1).

Table 1. Uranium legacy sites covered by the Strategic Master Plan

<table>
<thead>
<tr>
<th>Kyrgyzstan</th>
<th>Tajikistan</th>
<th>Uzbekistan</th>
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</thead>
<tbody>
<tr>
<td>Kadji-Say</td>
<td>Adrasman</td>
<td>Charkesar</td>
</tr>
<tr>
<td>Kara Balta&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Buston&lt;sup&gt;c&lt;/sup&gt;</td>
<td>Yangiabad</td>
</tr>
<tr>
<td>Kyzyl-Djar&lt;sup&gt;b&lt;/sup&gt;</td>
<td>• Degmay</td>
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<td></td>
<td>• Gafurov</td>
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<td></td>
<td>• Karta 1–9</td>
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<tr>
<td>Min-Kush</td>
<td>• Khujand</td>
<td></td>
</tr>
<tr>
<td>Shekaftar</td>
<td>Istiklol&lt;sup&gt;d&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Tuya-Moyun&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
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</tbody>
</table>

<sup>a</sup> The legal status of the Kara Balta plant and its tailings piles is being clarified; a decision will then be taken (foreseen in mid 2018) on whether its remediation should be covered by the Plan. The site is currently privately owned by a Kyrgyz company (Open Joint Stock Company Karabaltinskiy Mining Plant (OJSC-KBMC)) but processing facilities are no longer operational. Tailings piles are being leased from the Government of Kyrgyzstan, which appears to have ultimate responsibility for their remediation.

<sup>b</sup> These sites are not a priority for remediation (see Table 3) and the volumes of waste are small compared with those at other legacy sites (see Appendix A). The Plan includes a provision to evaluate and, if necessary, remediate these sites when remediation of the priority sites has been completed; this is in accordance with one of the guiding principles of the strategy (see Section 2) to adopt a step-by-step approach to remediation, focussing initially on sites presenting the highest risk and then sites with lower risk.

<sup>c</sup> Formerly Chkalovsk.

<sup>d</sup> Formerly Taboshar.

identified and the need for their remediation evaluated, while recognizing that they will have lower priority than the sites listed in the table.

Uranium mining and processing activities have been carried out in Central Asia since the mid-1940s, often centred on the mountainous areas above the valley of the Syr Darya river, where the territories of Kyrgyzstan, Uzbekistan, Tajikistan and Kazakhstan intersect (see

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ULS in Kazakhstan may be included in any further development and revision of this Strategic Master Plan.
Figure 1). Many of these activities ceased in the 1990s following the fall of the Soviet Union, leaving a legacy of abandoned uranium mining and milling sites, together with associated waste rock and low grade ore dumps, and tailings piles and ponds.

Central Asia is a region where future development depends on the availability of water resources. The Syr Darya river provides water to the ethnically diverse Ferghana valley, a fertile, 22 000 km² agricultural region that produces cotton, grains, tobacco, vegetables and fruit, and is home to 14 million people.

The ULS are located in a seismically active region, vulnerable to earthquakes and associated landslides. The mountain streams and rivers are often fast flowing and prone to flooding, particularly following snowmelt. This can potentially cause erosion and mudslides, events that are becoming more frequent as a result of climate change. In some cases the population in the vicinity of these legacy sites had increased to provide workers for the facilities, but has generally declined following their closure, as people, particularly the young, seek work elsewhere. These areas are often economically poor, with high levels of unemployment and reliance on subsistence farming. Other legacy sites are close to large centres of population — for example, over 1 million people live in the wider Khujand area.

Few protective measures had been in place prior to mine and mill closures and little remediation has since been carried out at the disused facilities and waste sites. Where measures have been put in place, they generally fail to meet current standards of good international practice. Mine shafts, tunnels and adits often remain open and accessible to local people and livestock. Rainwater can enter the mine systems, become contaminated and be used for human consumption or irrigation. Waste rock and low grade ore dumps are often not or only poorly covered, and are open to the elements. Material from such dumps has been and continues to be used in the construction of local public and private buildings.

The tailings piles provided the repository for waste from uranium ore processing operations. The tailings are produced in the form of a slurry, and are generally deposited behind some form of dam structure with a drainage system to allow settlement and removal of water from the slurry, and/or to prevent the entry of water from outside. The legacy tailings piles are also often easily accessible, and have little or no cover. Their drainage systems may no longer function, posing risks to the stability of the pile and/or possible contamination of surface water or groundwater. There is also the possibility of structural failure or dam collapse as a result of erosion, or triggered by events such as floods, earthquakes, landslides and mudslides.

These legacy facilities pose serious risks to the environment and public health. These include physical risks to people or animals — for example, falling into shafts or sinkholes, or becoming trapped by tunnel collapse, as well as radiological and toxicological risks from living in close proximity to the radioactive and toxic material remaining in the facilities. This could occur through direct exposure to radiation from the material, through inhalation of contaminated dust or radon gas emissions, and through consumption of contaminated water or foodstuffs (derived from livestock grazing or crops grown on contaminated land).

Local people often see the legacy facilities simultaneously as a potentially useful resource providing, for example, building material, valuable scrap, grazing land, etc. and as a source of concern with respect to actual and perceived health risks. The waste dumps and, particularly, the tailings piles also pose local and wider risks at a regional level because of the possibility of structural failure, which could lead to widespread and transboundary dispersion of the radioactive material via the Syr Darya river system.

Left unremediated, the legacy sites will be an enduring source of elevated exposure to radioactive and toxic material for generation after generation, with implications for health and wellbeing.

The release of radioactive and toxic legacy wastes into rivers is inevitable as long as the sites remain unremediated: it is not a question of ‘if’ but ‘when’.
Such releases, depending on when and where they occur and their magnitude, may require lasting restrictions on the use of water downstream for drinking and irrigation, and/or its treatment to reduce the levels of radioactive or toxic material to tolerable levels. The imposition of such restrictions or treatment would have major implications for the health and economic wellbeing of the population in the Ferghana valley, where agriculture is a major contributor to gross domestic product (GDP) and to national food supplies. Waste releases may also affect stability and security in the region.

Faced with these very challenging inherited problems, Kyrgyzstan, Tajikistan and Uzbekistan generally do not have the means to remedy them in the foreseeable future. As has been formally recognized in the December 2013 resolution of the General Assembly of the United Nations [5] and by numerous IAEA General Conference resolutions [6], it is incumbent upon the international community to assist these countries in remediating the legacy sites, and thereby avert this major threat to health, environment, stability and security. The Strategy and the Plan for its implementation set out in this document are intended to provide a sound and robust framework for this purpose.

1.3 Benefits to be gained from implementing the Strategic Master Plan

Investing and consolidating the resources for remediating these sites in accordance with the Strategic Master Plan will bring the following benefits:

- Directly improve the quality of life of those affected by the uranium legacy sites, both by reducing the actual risks posed (physical, radiological, toxicological, short and long term, continuous and accidental) to levels that are in line with internationally accepted norms and sustainable over the long term, and by addressing the perceived risks associated with these facilities.

- Contribute to enhanced stability and security in the region by reducing the potential for the uncontrolled dispersion or transfer of radioactive and toxic materials across national borders.

- It will prevent the further dispersion of radioactive and toxic materials as a consequence of human activities or natural events, which has the potential to substantially increase the area of contamination and the costs of environmental remediation to the point where it may become unaffordable.

- It will facilitate sustainable development by removing blight from these areas, by improving amenity and the natural environment, and by bringing land back into productive use for agricultural and human habitation or other purposes.

The strategic and integrated approach set out in the Strategic Master Plan will enable the best use to be made of the limited financial and human resources available for environmental remediation at the national, regional and international levels. It will:

- Align remediation activities with explicitly stated and commonly agreed goals that are sustainable over the long term;

- Address the risks on a systematic and consistent basis across the whole region;

- Address the risks on a phased basis, taking full advantage of potential economies of scale, while remaining within the limits of the funding, capabilities and capacities that can be provided;

- Share and coordinate resources in the affected Member States so that expertise in short supply at a national level (e.g. for regulatory oversight) can be enhanced when needed;
• Strengthen cooperation and common understanding among the affected Member States of the need for a regional approach and regional solution to address the uranium legacy issue;

• Establish and use common infrastructure, methods, databases, etc., where appropriate;

• Mobilize wider international efforts and capabilities for the environmental remediation of ULS in Central Asia;

• Further develop and enhance capacities at a national level, and across the region as a whole, so that risks posed by ULS can be managed over the long term without a need for external support;

• Contribute to sustainable socioeconomic development in the affected areas.
2. Strategy for environmental remediation of uranium legacy sites in Central Asia
2. **Strategy for environmental remediation of uranium legacy sites in Central Asia**

The strategic objectives for remediation are:

- To remediate uranium legacy sites in Central Asia in accordance with international standards and good practice;
- To reduce the risks to people and the environment to tolerable and sustainable levels;
- To contribute to improved health and socioeconomic conditions and amenity in the affected areas;
- To contribute to greater stability and security in the region by minimizing the risk of radioactive and/or toxic material being dispersed across national borders (e.g. via rivers or other water bodies);
- To establish, through regional cooperation, a larger and more sustainable critical mass of knowledge and expertise within Central Asia for undertaking remediation and regulating its safety.

The guiding principles for achieving the strategic objectives are as follows:

- Adopt a systematic, integrated and coherent approach to environmental remediation of ULS in Central Asia that is cost effective, in line with international standards and good practice, contributes towards stability and sustainable development in the region, and avoids potential duplication by different donors;
- Ensure, through cooperation, partnership and the involvement of interested parties, that the Strategic Master Plan and national strategies and plans for remediating uranium legacy sites, and the implementation of the national strategies and plans, are and remain aligned;
- Build on and fully exploit experience gained in the remediation of uranium legacy sites elsewhere, in particular in Central Asia;
- Ensure that the scale, nature and timing of remediation activities (i.e. including evaluation of remediation options and implementation of the preferred option) are compatible with:
  - National legislation and the requirements of regulatory authorities;
  - The capacities of the site owners and, in particular, the regulatory authorities;
- Adopt a step-by-step approach to remediation in the region, focusing first on those uranium legacy sites (or objects\(^{19}\) within them) judged to present the highest risks (or be deemed to be the highest priority), and when remediation of these sites or objects is complete, progressing to those judged to present a lower risk (or lower priority), on the following time-scale:

\(^{19}\) ‘Object’ is the term used in this document to denote an item located on a ULS that presents a risk requiring remediation (e.g. an open mine shaft or adit, a waste dump, a tailings pile, contaminated land, contaminated water, facilities/installations involved in the processing of uranium ore).
o Remediate, within the next 10 years and in accordance with international standards and good practice, all sites or objects judged to present the highest risks, or that have been identified as priorities taking account of broader socioeconomic or political considerations;

o Remediate, within the next 10 to 20 years and in accordance with international standards and good practice, all sites or objects judged to present lower risks, and/or that were not identified as priorities when taking account of broader considerations;

• When developing environmental remediation plans for ULS:

o Give preference to approaches that address the risks of legacy sites as a whole and in an integrated manner, i.e. taking full advantage of synergies in remediation options (thereby making the best use of the available resources), and avoiding ad hoc improvements being made to different risk objects at different times (thereby avoiding misperceptions over the adequacy and completeness of the remedial work, and enhancing public trust and confidence).

This would not preclude a step-by-step approach to remediation of individual objects on a site according to their relative risks, but means only that the remediation of each should be seen as part of a broader and fully integrated whole;

o Give consideration also to the remediation of objects presenting only a chemical or toxicological risk (in addition to those presenting a radiological risk), in particular where failure to do so would result in not being able to fully achieve some of the key objectives of remediating ULS, i.e. the reduction of health and environmental risks to tolerable levels and the return of legacy sites to beneficial use;

o Give preference to the use of remediation options that minimize the need for long-term human intervention to maintain their efficacy.

Specific actions that will be carried out to underpin this strategy are as follows:

• Channel and coordinate third party funding and support for the environmental remediation of ULS in Central Asia through the EBRD’s ERA for Central Asia; funding and support from CIS Member States is currently being channelled and coordinated through the ‘CIS Inter-State Targeted Programme on Remediation of Member State Territories affected by Uranium Mining Industries’.20

These arrangements are without prejudice to funding and support being provided through other mechanisms (e.g. bilateral arrangements) where the use of one or other of the above approaches is not possible;

• Hold a high level donor or pledging conference in 2018, seeking contributions to the ERA;

• Support Central Asian Member States in developing and/or further refining their national strategies and plans for remediating their uranium legacy sites, in particular ensuring that they are and remain consistent with the Strategic Master Plan;

20 Hereafter referred to as the CIS Programme.
• Support Central Asian Member States in implementing their national strategies and plans for remediating uranium legacy sites, in particular ensuring that there is an appropriate independent regulatory body with responsibility for implementing the legal and regulatory framework, and with adequate authority, competence and financial and human resources to carry out its assigned responsibilities;

• Develop and promote the use within Central Asia of a common and agreed methodology for assessing the health and environmental risks of uranium legacy sites, and for establishing priorities for remediation that take account of technical, socioeconomic and political considerations and amenity value;

• Develop mechanisms to ensure that third-party support and funding for actual remediation (e.g. from the CIS Programme, ERA or bilateral arrangements) are conditional on the existence of:
  o A systematic and comprehensive evaluation of the risks presented by a legacy site and options for its remediation, including costs;
  o Identification of the preferred option or options;
  o A technical specification of the remediation works to be undertaken and their costs; and the approval of the relevant national authorities regarding, for instance, the safety and sustainability of the proposed remediation. An Environmental Impact Assessment (EIA) would be an essential part of this process;

• Establish a mechanism to support national authorities, where necessary, in regulating the safety and sustainability of proposed remediation;

• Further enhance regulatory frameworks and the capacities and capabilities of regulatory authorities in Central Asia to regulate the safe and sustainable remediation of uranium legacy sites;

• Further enhance cooperation between those responsible for regulating the safety of uranium legacy sites in Central Asia, in order to:
  o Achieve a more common understanding and harmonized approach to regulating the safety of ULS;
  o Achieve a larger critical mass and making best use of limited skills and knowledge at national levels for undertaking remediation and regulating its safety;
  o Adopt good regulatory practice across the whole region;
  o Enhance public trust and confidence through the adoption of common approaches;

• Further enhance the capacity and capabilities of owners of uranium legacy sites in each country to enable them to plan and carry out remediation works and put in place post-remediation mechanisms that are sustainable;

• Further enhance the capabilities and capacities of Central Asia for long-term monitoring, surveillance and maintenance of remediated sites to ensure their continuing safety (i.e. post-remediation activities);
• Support Central Asian Member States, where necessary, in fulfilling their obligations as Contracting Parties to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, in particular in the preparation and submission of national reports to the review meetings;

• Support Kyrgyzstan and Uzbekistan in acceding to or ratifying the Convention on Early Notification of a Nuclear Accident in order to minimize the radiological consequences of any emergency or accident at a ULS on their territory that may have transboundary implications;

• Support the establishment and operation of (a) a sustainable regional system that integrates national systems for providing early warning of a significant release of contaminants to rivers (in particular those with potential cross-border implications) and (b) tools to assess the impact of any release and how it can be mitigated by timely intervention;

• Support activities aimed at better informing and engaging interested parties, in particular those living and working locally, building on recent initiatives by the United Nations Development Programme (UNDP), the Organization for Security and Co-operation in Europe (OSCE), the United Nations Environment Programme (UNEP) and others;

• Support the development and use of a common information system for the exchange of information on uranium legacy sites within the affected countries;

• Establish a mechanism for the core group of CGULS to monitor the implementation of the Strategic Master Plan and update it as necessary;

• Establish a mechanism for coordination between the EBRD’s ERA and the CIS Programme in the funding and implementation of environmental remediation of ULS in Central Asia.
3. Master Plan for implementing the strategy
3. Master Plan for implementing the strategy

The Strategic Master Plan provides a sound technical and financial framework for the implementation of the strategy, and to enable the international community and potential donors to make well-founded decisions on supporting environmental remediation.

In accordance with the strategic principles, the Plan takes as its starting point, and builds on, relevant activities already carried out by Kyrgyzstan, Tajikistan and Uzbekistan themselves, as well as those undertaken with support from various other sources. These include the CIS, the EBRD, the European Union (EU), the IAEA, UNDP, UNEP, the World Bank, the OSCE, the International Science and Technology Center (ISTC), the North Atlantic Treaty Organization (NATO), Germany’s Federal Institute for Geosciences and Natural Resources (BGR), the Norwegian Radiation Protection Agency (NRPA) and the Swiss Foundation for Mine Action (FSD).

The costs of remediation will generally far exceed national budgetary resources for such activities in each Member State. The timing of remediation will therefore depend critically on the availability of funding from third parties. As a consequence, some aspects of the Plan can be no more than indicative at this stage, and will only be able to be confirmed when the funding situation becomes clearer. Nonetheless, the Plan identifies some milestones for decisions, contingent upon the availability of funding.

It comprises the following main elements:

1. Ranking of the sites (and/or objects within them) in terms of risk and/or priority for remediation;
2. Establishing a systematic, coherent, cost-effective and fully integrated approach for evaluating the need for and nature of remediation. This should be applied prior to decisions on funding the remediation of one site or another so that its outcomes can inform those decisions);
3. A programme\(^{21}\) setting out the main tasks or activities to be undertaken within the Plan, along with associated schedules, milestones (road map) and costs;
4. Institutional and organizational arrangements and funding for implementing the Plan.

\(^{21}\) The programme programme covers two distinct types of activity: (a) activities related specifically to the legacy sites: in particular, evaluation of the risks and options for remediation of each site, selecting the preferred option, undertaking the remediation and putting in place any necessary post-remediation arrangements and (b) activities relating to supporting measures, focusing on further capacity-building and enhancing cooperation in the region, without which the planning and execution of remediation at the legacy sites might be adversely affected in terms of time and/or costs.
3.1 Ranking of sites and/or objects in terms of risk and/or priority for environmental remediation

In 2009, the IAEA, in cooperation with the EC, developed the Technical Baseline Document [1] on uranium legacy sites in Central Asia. This document described the main characteristics of each site, together with the continuing risks that they presented if they remained unremediated. Semi-quantitative judgements were made of the overall risk at each site (and for individual objects within them), together with rough estimates of the costs of, and timescales for, remediation. Based on this assessment, a number of sites, judged to present a high or medium risk, were identified as priorities for environmental remediation.

In developing the baseline document, account was taken of the outcomes of previous international assessments (e.g. those undertaken by the IAEA, Technical Assistance to the Commonwealth of Independent States (TACIS), the International Association for the Promotion of Cooperation with Scientists from the Independent States of the former Soviet Union (INTAS), NATO, the Environment and Security Initiative (ENVSEC), UNDP, OSCE, ISTC) and of all information readily available at the time for the various sites.

Resource constraints and the incompleteness of the information then available (e.g. on the geotechnical stability of tailings ponds) limited the depth and rigour of the analyses that could be made, and the estimates, particularly of cost, can only be regarded as indicative.

Nonetheless, the baseline document continues to provide an adequate basis for the initial ranking of sites and objects for the purposes of deciding which should be prioritized for more detailed evaluation.

The risk rankings (categorized as high, medium and low) as assessed in the baseline document by both national and international experts are summarized in Table 2. The rankings by both sets of experts are broadly consistent, given that they are largely judgement based. They are also consistent with rankings made in 2006 by the CIS Nuclear Commission concerned with remediation of territories of its Member States affected by uranium mining industries [14].

National priorities for the remediation of sites can also be found in, or inferred from, presentations made in various forums [7, 9, 11, 12] and national concepts, strategies or plans for remediation [8, 10, 16]; these are also shown in Table 2. Implicit or explicit judgements on priorities have also been made by the European Commission in determining the scope and nature of support given to countries in Central Asia for remediation of ULS, i.e. in determining the sites where more detailed studies have been undertaken, or are planned under the auspices of the EU's Instrument for Nuclear Safety Cooperation (INSC), on the risks of ULS and options for their remediation.

Priorities established at national levels, by the CIS Programme and those that can be inferred from support provided by the EU's INSC are broadly consistent with those in the baseline document.

Some Central Asian countries have prioritized sites/objects for remediation. The prioritized or ranked list for remediation in Tajikistan is shown in Table 3.1, and that for Kyrgyzstan in Table 3.2. The ranked list for Tajikistan is based on priorities identified in the national programme for realization of the national concept for remediation [12, 16]. The list differs from that in the concept itself [10] and reflects more recent developments and changing circumstances at some sites (e.g. remediation at Adrasman was assigned a higher priority following the erosion and dispersion of material from one of its tailings ponds, while Gafurov is no longer considered to be a priority as it has since been adequately remediated).

The ranked list for Kyrgyzstan is based on priorities identified in its comprehensive programme for remediation [8], updated to take account of, for example, more recent developments and changed circumstances [9]. The most significant change is the addition of the Kara Balta site, where facilities for the processing of uranium have now ceased operation and large amounts of tailings need remediation.
<table>
<thead>
<tr>
<th>Republic</th>
<th>Site</th>
<th>Risk ranking/Priorities for remediation</th>
<th>Baseline document</th>
<th>National Plans/Strategies</th>
<th>CIS(^c)</th>
<th>EU INSC(^d)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>International Experts</td>
<td>National Experts</td>
<td>Kyrgyzstan(^a)</td>
<td>Tajikistan(^b)</td>
</tr>
<tr>
<td>Kyrgyzstan(^a)</td>
<td>Mailuu-Suu</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Min-Kush</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td></td>
<td>Kara Balta</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kadji-Say</td>
<td>M</td>
<td>M</td>
<td>H</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shekaftar</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tajikistan</td>
<td>Istiklol(^f)</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Buston(^g)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Degmay</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Khujand</td>
<td>M</td>
<td>M</td>
<td>L</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Karta 1–9</td>
<td>M</td>
<td>L</td>
<td>M</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Gafurov</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Adrasman</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uzbekistan</td>
<td>Charkesar</td>
<td>M</td>
<td>H</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yangiabad</td>
<td>M</td>
<td>M</td>
<td>n/a(^b)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

H = high risk/priority; M = medium risk/priority; L = low risk/priority
\(^a\) Kyrgyzstan; as set out in [7–9].
\(^b\) Tajikistan; as can be inferred from the ranking of individual objects at each site [10, 11] and subsequent refinement [12].
\(^c\) Priorities identified in the CIS Programme\(^{22}\) [13] (limited to remediation of ULS in Kyrgyzstan and Tajikistan) based on ranking made in [14].
\(^d\) Priorities inferred from projects being implemented with support from the EU’s Instrument for Nuclear Safety Cooperation (INSC) to evaluate risks and remediation option/s for particular ULS or objects [15].
\(^e\) The two waste dumps at Kyzyl-Djar and Tuya-Moyun are not priorities for remediation and the volumes of waste are small compared with those at other legacy sites (see Appendix A). The sites will be evaluated and, if necessary, remediated when remediation of the priority sites has been completed.
\(^f\) Formerly Taboshar.
\(^g\) Formerly Chkalovsk.
\(^h\) Not applicable – CIS Programme limited to Kyrgyzstan and Tajikistan.

\(^{22}\) The CIS Programme was originally established under the EurAsian Economic Community (EurAsEC). When EurAsEC ceased to exist, implementation of the programme continued under the auspices of the CIS without change in the scope, content or scheduling of the Programme. For convenience and clarity, reference is made to the CIS (as opposed to the EurAsEC) Programme throughout the remainder of this document — while recognizing that in some cases reference to EurAsEC would have been more exact.
Table 3.1. Priorities for environmental remediation of sites/objects at ULS in Tajikistan [10, 12]

<table>
<thead>
<tr>
<th>ULS</th>
<th>Object/s</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degmay</td>
<td>Tailings pond</td>
<td>1</td>
</tr>
<tr>
<td>Istiklo(^a)</td>
<td>Yellow Hill(^b) and tailings ponds 1–4</td>
<td>2</td>
</tr>
<tr>
<td>Adrasman</td>
<td>Tailings pond 2</td>
<td>3</td>
</tr>
<tr>
<td>Buston(^c)</td>
<td>Tailings Karta 1–9</td>
<td>4</td>
</tr>
<tr>
<td>Khujand</td>
<td>Adits, waste rock piles and mine water</td>
<td>5</td>
</tr>
</tbody>
</table>

\(^a\) Formerly Taboshar.
\(^b\) A waste dump comprising low grade uranium ores and barren ore residues following in situ leaching, commonly referred to as Yellow Hill.
\(^c\) Formerly Chkalovsk.

Table 3.2. Priorities for environmental remediation of sites/objects at ULS in Kyrgyzstan [8, 9]

<table>
<thead>
<tr>
<th>ULS</th>
<th>Object/s</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mailuu-Suu</td>
<td>Tailings, landslides</td>
<td>1</td>
</tr>
<tr>
<td>Min-Kush</td>
<td>Four tailings sites and stabilization</td>
<td>2</td>
</tr>
<tr>
<td>Kara Balta</td>
<td>Tailings</td>
<td>3</td>
</tr>
<tr>
<td>Kadij-Sai</td>
<td>Tailings</td>
<td>4</td>
</tr>
<tr>
<td>Shekaftar</td>
<td>Waste rock dumps</td>
<td>5</td>
</tr>
</tbody>
</table>

Given the broad consensus on priorities for remediation, the rankings in Tables 2, 3.1 and 3.2 will be used to guide the implementation of the strategy, subject to any update or revision of national strategies or concepts for remediation that reflect improved estimates of risk, changed conditions at one or other site/object and/or changes in the socioeconomic situation.

3.2 An integrated and systematic approach to environmental remediation

3.2.1 The need for an integrated and systematic approach

The support provided to countries in Central Asia for remediation of ULS since they gained independence has typically involved the efforts of a large number of actors, often operating independently. Such uncoordinated support, while well intentioned, is unlikely to have made the best use of resources and may, in some circumstances, have been counterproductive.

With the notable exception of a World Bank project at Mailuu-Suu in Kyrgyzstan, the funds available resulted in studies that were often small in scale and tended to highlight issues rather than implement solutions, and there was a focus on purchasing equipment and on training. In addition, the absorption capacities of both the owners of ULS in the affected Member States, and those responsible for regulating their safety, may not have been sufficient to assimilate support effectively from multiple sources.

The pooling of funds through the EBRD’s ERA and the CIS Programme, and the adoption of this Strategic Master Plan, are intended to provide access to the larger sums needed to support actual remediation work and promote a more integrated and systematic approach to remediation. In addition, some of the other problems have been, and continue to be, addressed with the establishment in 2012 of the Coordination Group for Uranium Legacy
Sites (CGULS), whose objectives are to provide a forum for information exchange and provision of technical advice, and to coordinate the actions of the members to maximize synergies and avoid duplication of effort. Within the framework of CGULS, a core group has been established to develop this Strategic Master Plan for remediating uranium legacy sites, monitor its implementation and oversee its periodic updating.

The principles underpinning the Plan, together with the institutional and organizational arrangements established for its implementation (see Section 3.6), will ensure the adoption of an integrated, systematic and coherent approach to remediation of ULS in Central Asia. The following factors will be important in achieving this goal:

- A common, systematic approach for evaluating the health and environmental risks of ULS and options for their remediation should be adopted;
- Third-party support and funding for remediation should be conditional on the existence of:
  - A systematic and comprehensive evaluation of the risks presented by a legacy site (or an object within it) and options for its remediation, including costs;
  - Identification of the preferred option or options; a technical specification of the remediation works to be undertaken and their costs;
  - Approval by the relevant national authorities regarding, inter alia, the safety, environmental acceptability and sustainability of the proposed remediation (an environmental impact assessment, including engagement and consultation with interested parties, would be an essential part of this process);
- The scale, nature and timing of remediation activities (both to identify preferred options and subsequent remediation) should be compatible with the capacities of the site owners and the regulatory authorities;
- National regulatory authorities should, where necessary, be supported in carrying out reviews and approving the safety and environmental acceptability of any proposed remediation, during both the planning and implementation stages;
- A mechanism for coordination should be established between the EBRD’s ERA and the CIS Programme in the funding and implementation of remediation activities;
- Information should be shared between all parties with a view to better informing decisions by the main funding bodies (ERA, CIS Programme and national programmes) on the relative priority and timing of remediation of the various sites and/or objects;
- Cooperation should be established with regional and/or international development organizations (e.g. UNDP) so that remediation is accompanied by sustainable socioeconomic improvements in the affected areas.

The core group of CGULS will put in place appropriate arrangements and develop guidance to ensure these outcomes (see Section 3.6).

Giving timely attention to each of the above issues will enhance the efficiency and efficacy of remediation at all stages in the process, and build public confidence and trust in what is being done, both among local communities and their political representatives.

On the other hand, allowing different, unsubstantiated solutions or approaches to be developed to what appears to be the same problem at different sites will generate public concern, and would be prejudicial to the objectives of the remediation.
3.2.2 Approach to be adopted in the Plan in determining the need for and nature of environmental remediation

A systematic, coherent and fully integrated approach will be adopted within the master plan in determining the need for, and nature of, any remediation. The key steps or elements of the approach are set out below and illustrated in Figure 2. Satisfactory fulfilment of these steps will be a prerequisite for any remediation to be implemented under the auspices of the Strategic Master Plan.

The adoption of this approach, as an integral part of the Plan, will provide a high degree of assurance that any remediation undertaken will be well conceived, practicable, sustainable, cost-effective, capable of achieving support from interested parties and unlikely to encounter any undue problems in gaining regulatory approval.

The key steps for each remediation project are to:

- Carry out a comprehensive risk assessment for a ULS as a whole, or an object or objects within it, in accordance with good international practice;
- Evaluate remediation options in accordance with good international practice, taking into account an EIA and consultation and engagement with interested parties;
- Undertake pilot studies if these are necessary to refine cost estimates or demonstrate the practicability of one or other proposed remediation option;
- Select preferred remediation option or options;
- Develop a technical specification and costing for the optimal/preferred remediation option (including post-remediation activities), together with a safety assessment;
- Seek regulatory review and approval for the proposed remediation;
- Subject to availability of funds, launch tender;
- Determine successful tenderer and implement remediation;
- Support regulatory authority, as necessary, in its oversight and approval of the remediation (during both the planning and implementation stages) and foreseen post-remediation activities (e.g. monitoring, maintenance);
- Support ULS owners as necessary in exercising long-term stewardship of remediated sites (e.g. developing capacity to undertake inspections, monitoring, maintenance, corrective actions).

Further information on what would be considered good international practice in this context is set out in Appendix C.

3.3 Environmental remediation of uranium legacy sites

The plan and road map for each site judged to present a high or medium risk, and/or considered as a priority for environmental remediation, are described below for each Member State. Figures are provided illustrating the locations of the uranium legacy sites in each country, as well as photographs of selected sites.

More detailed information on the main characteristics of each site is provided in Appendix A, including supporting material to enable the reader to appreciate more fully the nature and extent of the risks presented by the various ULS, and the pressing need for their remediation. For many of these sites, investigations are already under way or have been carried out to identify and evaluate remediation options, either for the sites as a whole or for priority objects within them. The results of completed investigations are described in Appendix B; and summary information is included below.
3.3.1 Kyrgyzstan

Figure 3.3.1. Locations of uranium legacy sites in Kyrgyzstan.
Adapted from maps provided by the UN Geospatial Information Section.

3.3.1.1 Mailuu-Suu

Covered tailings at Mailuu Suu, Kyrgyzstan

The World Bank’s Disaster Hazard Mitigation Project supported the remediation of high risk objects at Mailuu-Suu in the period 2004–2013 [17]. A geologically unstable tailings facility on the banks of the Mailuu-Suu river was moved to a more secure and stable location, and a waste rock dump on the banks of the Kulmen Say creek was similarly relocated. Another waste rock dump on which homes had been built was also relocated, requiring the resettlement of the residents.

This project demonstrated that remediation work at uranium legacy sites of significant scale can be successfully implemented in the region. As a result of the programme, as well as earlier and accompanying studies, the characteristics of the Mailuu-Suu site are well understood. The work undertaken also revealed the extent of remediation required and the budget was increased to a total of US$12 million. However, temporary stabilization works could not be followed up with more sustainable measures because of administrative and
financial constraints, and some health concerns persist among the local communities.

Building on this work, a systematic and comprehensive evaluation of risks and remediation options for the whole Mailuu-Suu site is currently being undertaken with support from the EU’s INSC [18]. This evaluation is scheduled for completion by the second quarter of 2019. Detailed technical specifications of the final remediation plan will then be available, together with cost estimates, safety assessments and regulatory approvals for the proposed remediation of each object.

A decision on if and when to proceed with further remediation at Mailuu-Suu is foreseen in the Plan in the third quarter of 2019. Subject to the availability of funds, remediation could begin in early 2020 following a tendering process.

3.3.1.2 Min-Kush

Two evaluations have been made of the risks and options for the remediation of the Min-Kush site or objects within it: the first [19], undertaken with support from the EU’s INSC, covered the whole site, while the second [20], undertaken with support from the CIS Programme, focused only on the tailings ponds that were judged to present the highest risks on the legacy site.

The options proposed in the two studies for remediation of the tailings ponds are broadly comparable, apart from the pond at Taldy-Bulak. Both studies propose the relocation of tailings from the pond at Tuyuk-Suu to the tailings pond at Dalnee (see Figure A4 in Appendix A) and in situ remediation of the tailings at Kak (see Table B2 in Appendix B).

The INSC-supported project proposes in situ remediation of the tailings pond at Taldy-Bulak, whereas the CIS project proposes the relocation of these tailings to Dalnee. The investigations carried out by the CIS project identified that degradation of the protective engineering structures at Taldy-Bulak, coupled with climate change in the region, had increased the risk of significant release of tailings material due to natural emergencies. The magnitude of this
risk was considered sufficient to justify the relocation of the tailings, albeit at greater cost. The estimated remediation costs for the two options are around ₽1.5 billion\(^{23}\) (€23 million\(^{24}\) and around €20 million, for the CIS- and INSC-supported studies, respectively. These two estimates are broadly comparable, given the differences in the scope and nature of the remediation work being proposed.

Kyrgyzstan has decided to proceed with remediation of the tailings ponds at Min-Kush with support and funding from the CIS and in accordance with the remediation options proposed in its study.\(^{25}\) Remediation is expected to begin in 2017 and be completed within six years, i.e. by the end of 2022; new roads will need to be constructed between Dalnee and the tailings ponds at Tuyuk-Suu and Taldy-Bulak (see Figure A4 in Appendix A) to enable the transport of the tailings and dams to be excavated from these two locations.

Options for remediating other objects (apart from tailings ponds) that presented a significant risk on the Min-Kush site were also assessed in the INSC-supported project. Technical specifications, costings and safety assessments have been prepared for: the closure of seven shafts or adits and seven sink-holes; the demolition of buildings at the processing site, including a bunker and a mill facility, with in situ disposal; and various activities at three waste rock dumps concerned with the drainage, discharge or diversion of water.

The estimated cost is about €4.1 million, and remediation would take between one and two years to complete. Further information on the proposed remediation can be found in Appendix B. The plan foresees a decision in the third quarter of 2017 on if and when to remediate these objects taking account of the availability of funds and competing priorities.

### 3.3.1.3 Kara Balta

The Kara Balta site has been in private ownership since 2008. The current owner is a Kyrgyz company, Open Joint Stock Company Karabaltinskiy Mining Plant (OJSC-KBMC). The intent was to reprocess the whole of the tailings at Kara Balta to extract residual uranium and other metals (e.g. molybdenum), and while doing so, to remediate the tailings dump in accord with state of the art international practice.

To date, no significant reprocessing of the tailings appears to have been undertaken, nor have the tailings been remediated in any way. Activities are now limited to ensuring the safety and security of the site with minimal levels of staffing. The cessation of operations indicates that the planned extraction of uranium and other metals from the tailings is no longer judged to be economic or practicable.

While the site remains in private ownership, ownership of the tailings appears to remain with the Government, which leased/rented the tailings to the site owner (OJSC-KBMC) for a period of 49 years from 2009 under a Governmental Decree. In these circumstances the tailings appear to be a legacy and have therefore been included in this Strategic Master Plan, at least provisionally.

At the time of printing, Kyrgyzstan is clarifying the precise legal status of the tailings, and the outcome will determine whether this site remains within future revisions of the Plan.

Given the size of the tailings and concerns about their safety, a decision should be taken at the earliest opportunity on whether the site should remain in the Plan, and, if so, when to carry out an evaluation of the risks and remediation options. The Plan foresees such a decision by mid-2018.

\(^{23}\) Russian roubles, denoted by ₽
\(^{24}\) Based on exchange rate of RUB 63.98/€ (January 2017)
\(^{25}\) In accordance with the Decision of the CIS Council of Heads of Government signed in Minsk on 28 October 2016.
3.3.1.4 Kadji-Say

Kadji Sai uranium legacy site, Kyrgyzstan

Initial attempts were made to remediate the waste pile at Kadji-Say in 2006 with support of US$400 000 from the International Science and Technology Center (ISTC). The pile was consolidated at a number of locations and covered with a mixture of ash-clay to minimize radon emanation and external radiation, and to protect the pile against erosion. The cover, however, was not complete and the material used was later found to be unsuitable. Free access to the site remains, and metal scrap continues to be excavated illicitly and sold.

A detailed evaluation, carried out under the auspices of the CIS Programme, has since been made of options for the further remediation of the tailings and other industrial wastes at Kadji-Say. The preferred option is in situ remediation, including the construction of a drainage channel to divert run-off and prevent erosion of the sides of the tailings pile, at an estimated cost of ₽ 97 million (€1.5 million)26. The remediation work is scheduled to begin in the second quarter of 2017 and to be completed within about one year.

A few buildings remain on site, and should be demolished and disposed of to complete the remediation of this uranium legacy site.

3.3.1.5 Shekaftar

Local homes next to waste rock piles, Shekaftar

26 Based on exchange rate of RUB 63.98/€ (January 2017)
A systematic and comprehensive evaluation of the risks and remediation options (including costs) for each object presenting a significant risk on the Shekaftar site has been carried out with support from the EU’s INSC [19]. The preferred/optimal options and costs for remediation of the site are summarized in Table B3 of Appendix B. They comprise the closure of six shafts and the relocation of five waste rock dumps to an existing dump at a more remote location. Technical specifications, costings and safety assessments have been prepared for each.

The five dumps to be relocated are in residential areas near to schools and other buildings; the sixth is on the banks of the Sumsar River, where there is a continuing risk of erosion of material into the river in the event of any breach or failure of existing buttresses.

The estimated costs (most of which are for the relocation of the waste dumps) amount to about €3.5 million, and remediation would take about two years to complete. The plan foresees a decision in the third quarter of 2017 on if and when to remediate these objects, taking account of the availability of funds and competing priorities.
3.3.2 Tajikistan

Figure 3.3.2. Locations of uranium legacy sites in Tajikistan. Adapted from maps provided by the UN Geospatial Information Section.

3.3.2.1 Istiklol

Abandoned mine buildings, Taboshar, Tajikistan
A systematic and comprehensive evaluation of the risks and remediation options (including costs) for the two objects that present the highest risks on the Istiklol (formerly Taboshar) site, i.e. Yellow Hill and tailings piles 1–4 (see Appendices A and B), has been carried out as part of the CIS Programme. The preferred option is to re-contour and cover Yellow Hill, improve the existing covers of tailings piles 1–4, dismantle building structures and leached heaps, and decontaminate adjacent areas. A preliminary estimate for the cost of the proposed remediation is 780 million (€12 million) but there are indications that the final costs may be somewhat higher.

Tajikistan has decided to proceed with remediation of Yellow Hill and tailings ponds 1–4 with support from the CIS Programme. The detailed design and specification of the proposed remediation will be evaluated by the Tajik regulatory bodies. Subject to regulatory approval, the CIS Council is scheduled to make a decision on funding the proposed remediation in the fourth quarter of 2018. Remediation would begin in 2019 and may take five to ten years, with the exact duration depending on the availability of funds.

With support from the EU’s INSC, an evaluation is also being made of the risks and remediation options for the whole of the Istiklol site — i.e. Yellow Hill and tailings piles 1–4, plus other objects presenting a significant risk [21]. An initial indicative estimate of about €20 million has been made for the cost of remediating Yellow Hill and tailings piles 1–4 on the Istiklol site, and about €13 million for the remediation of all other objects apart from the water treatment facility (see below). These estimates are preliminary and based on an as yet incomplete evaluation. The evaluation is scheduled for completion in the first quarter of 2018, when the preferred remediation option/s will be identified and their costs quantified in a more consistent and robust manner. A decision on if and when to remediate objects, other than Yellow Hill and tailings piles 1–4 is foreseen for the third quarter of 2018, subject to the availability of funds and competing priorities.

A water treatment facility is currently being designed and constructed with support from the EU’s INSC [22] to treat contaminated mine waters discharging from adits of an obsolete uranium mine on the Istiklol site, at an expected cost of about €2.5 million. The aim is to treat the mine water so that it is safe to use for crop irrigation and consumption by people and livestock. The detailed design, costing and safety assessment were scheduled for completion before the end of 2017; construction of the facility is scheduled for 2018, with commissioning and operation foreseen early in 2019.

3.3.2.2 Buston industrial complex

The Buston (formerly Chkalovsk) industrial complex contains a number of dispersed uranium legacy sites, in particular those located in Buston itself, at Degmay, Khujand and Gafurov (see Figure A7 in Appendix A). All four of these sites are included as priorities for remediation in the national concept [10], although some changes were made in their relative importance or ranking in the national plan for realization of the concept [12, 16].

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27 A waste dump comprising low grade uranium ores and barren ore residues following in situ leaching – commonly referred to as ‘yellow hill’.

28 Based on exchange rate of RUB 63.98/€ (January 2017)
3.3.2.2.1 Degmay

A systematic and comprehensive evaluation of the risks and remediation options (including costs) for each object presenting a significant risk on the Degmay site is being carried out with support from the EU’s INSC [21]. An initial indicative estimate of about €25 million has been made for the cost of remediating the Degmay site. This estimate is, however, preliminary and based on an as yet incomplete evaluation. The evaluation is scheduled for completion in the first quarter of 2018, when the preferred options for remediation will be identified and their costs quantified in a more robust and consistent manner. A decision on if and when to remediate the Degmay site is foreseen for the third quarter of 2018, subject to the availability of funds and competing priorities.

With resources from local and national budgets, about 10 ha of the overall tailings area (about 90 ha) has been covered with soil between 0.5 m and 1 m thick, and a further 20 ha is planned to be covered by 2017–2018. This cover is being provided as an intermediate and short-term measure, solely to respond quickly to increasing public concern over the risk from inhalation of radioactive tailings dust resuspended by the relatively high wind speeds in the area. Full remediation of the Degmay tailings piles will subsequently be required, and is the subject of the systematic and comprehensive evaluation of the risks and remediation options underway.

3.3.2.2 Karta 1–9 (also known as Chkalovsk or Buston tailings dumps)

In 2013–2014, a concrete wall about 1.8 km in length was constructed around the Karta 1–9 waste tailing dumps with funding from the FSD, as an emergency measure to limit public access. These dumps occupy an area of about 18 ha and hold more than 3 million tonnes of radioactive wastes containing uranium as well as arsenic and vanadium.

The FSD is planning to initiate an evaluation of risks and remediation options for the Karta 1–9 waste dumps sometime in 2017; while the focus will be on Karta 1–9, the scope of the studies will be extended to include industrial wastes at the TAJREDMET hydrometallurgical plant and some hot spots of radioactive contamination in the area.
Subject to the completion of the evaluations for Karta 1–9, the Plan foresees a decision sometime in 2018 on if and when to remediate these objects, taking account of the availability of funds and competing priorities.

### 3.3.2.2.3 Khujand and Gafurov

Khujand and Gafurov were identified as priorities for remediation in the national concept for remediation [10]. In the programme for realization of the concept [12, 16], remediation already carried out at Gafurov was judged by the Nuclear and Radiation Safety Agency (NRSA), Tajikistan's regulatory authority, to be sufficient and broadly in accord with good international practice; nonetheless, confirmation of this judgment by an independent evaluation would further enhance public confidence.

Khujand was ranked as a high priority in the national concept for remediation, but has been much downgraded in the programme for realizing the concept, largely due to a decision to recommission (with national funding) a water treatment facility for mine waters that were being used for irrigation and human consumption. New ion exchange resins will be installed, and when the facility is brought back into operation, water quality is expected to be compliant with national standards. In addition, uranium will be recovered during the periodic regeneration of the ion exchange resins, the commercial value of which will compensate, at least partially, for the cost of operating the water treatment facility. The need for remediation of other objects on the Khujand site, in particular waste rock piles, has yet to be fully evaluated.

The Plan foresees a decision in the fourth quarter of 2018 on if and when to initiate an evaluation of risks and remediation options for waste rock piles and other objects at Khujand, and to conduct an independent external evaluation of remediation already carried out at Gafurov to confirm it is sufficient.

### 3.3.2.3 Adrasman

The Adrasman site and objects on it were assigned a medium priority in the national concept for remediation [10], ranked seventh out of nine sites. In the programme for realization of the concept [12, 16], it has been assigned a higher priority and is now ranked third, below only the Istiklol and Degmay sites [12].

The covers and slopes of the tailings are not stable. In 2010 there was washout and carry-over of tailings material along the hillside that was subsequently dispersed over adjacent areas. Further dispersion of this material continues, with the risk of it reaching nearby rivers. Emergency measures had to be taken in 2013 to remedy the situation and constrain the further dispersion of the released material.

Given the increased risk and higher priority now given to this site, the Plan foresees a decision at the earliest opportunity on if and when to carry out an evaluation of risks and remediation options for this site as a whole, taking account of the availability of funds and competing priorities.
3.3.3 Uzbekistan

Figure 3.3.3. Locations of uranium legacy sites in Uzbekistan. Adapted from maps provided by the UN Geospatial Information Section.

3.3.3.1 Charkesar

Abandoned infrastructure, Uzbekistan
The Charkesar site was judged in the baseline report to present a medium to high risk (see Table 2). With support from the EU's INSC [23], a systematic and comprehensive evaluation of the risks and remediation options (including costs) has since been made for each object presenting a significant risk on the Charkesar-1 site.

The preferred/optimal options and costs for remediation of the Charkesar-1 site are summarized in Table B5 of Appendix B. They comprise:

- The closure of two shafts, one adit and five sinkholes;
- The demolition of abandoned buildings, with the debris to be used to fill sinkholes; and the removal and cleanup of small heaps of leached ore found along roadsides.

Technical specifications, costings and safety assessments have been prepared for each. The estimated cost is €600 000, and the remediation would take about one to two years to complete.

The plan foresees a decision in the first quarter of 2018 on if and when to remediate these sites/objects in accordance with the preferred/optimal options identified, taking account of the availability of funds and competing priorities.

Charkesar-2 is in the process of being remediated by the Government of Uzbekistan.

3.3.3.2 Yangiabad

Yangiabad was judged in the baseline report to present a medium risk (see Table 2). With support from the EU's INSC [23], a systematic and comprehensive evaluation of the risks and remediation options (including costs) has since been made for each object presenting a significant risk on this site.

The Yangiabad site is extensive, covering about 50 km², and incorporates a number of separate mines (Alatanga, Razveduchastok, Kattasay, Dzhekindek, Rudny Dvor) as well as central dumps for waste rock and low grade ore.

The proposed options and costs for remediation of the site are summarized in Table B4 of Appendix B. They comprise:

- The closure of four shafts, 23 adits and eight sinkholes;
- The demolition of contaminated buildings and/or processing facilities that have been abandoned, with debris transferred to central waste dumps or a storage cell;
- Discharge channels for surface water at five locations;
- River bank protection at four locations;
- Relocation of several waste rock dumps at Kattasay to a central dump that would be covered;
- A storage cell for contaminated material (e.g. metal), in particular from demolition of buildings and/or facilities at Rudny Dvor.

Technical specifications, costings and safety assessments have been prepared for each. The estimated costs amount to €6.3 million, and remediation (together with remediation at Charkesar) would take about three years to complete. Almost half of these costs are associated with remediation at Kattasay, in particular the relocation of several waste rock dumps to a central, covered dump.

The plan foresees a decision in the first quarter of 2018 on if and when to remediate these sites (in whole or in part) in accordance with the preferred/optimal options identified, taking account of the availability of funds and competing priorities.
3.3.4 Kazakhstan

Uranium legacy sites not in private ownership were remediated, at least partially, under a national programme from 2001 to 2010, when the programme was discontinued. The expected efficacy and sustainability of the remediation work were not achieved, in part due to deficiencies in the regulatory framework and a failure to assign responsibility for the long-term management of the sites. As a result, further work is needed to improve the situation and complete sustainable remediation of all sites.

With support from the IAEA, an action plan and budgetary proposal has been prepared for the Government of Kazakhstan to allocate funds for the dismantling and decommissioning of surface facilities, site cleanup, restoration of institutional control and establishment of a long-term monitoring and stewardship programme for the legacy sites.

At the time of printing it is foreseen that remediation of ULS in Kazakhstan will be undertaken with national resources as part of a national programme. Consequently, it is not given further consideration in this Strategic Master Plan, other than to monitor progress with the programme (under the auspices of the core group of CGULS), and to provide advice or technical support if requested. Given the considerable experience that Kazakhstan has gained in remediating its ULS, it could have an important role to play in any regional cooperation (see Section 3.4).
3.4 Capacity building and regional cooperation

Providing further support for capacity-building and regional cooperation are key elements of the strategy for remediating uranium legacy sites in Central Asia. Capacity-building, at both national and regional levels, will need to receive continuing attention in parallel with the actual remediation of sites and objects in the affected Member States, and with subsequent post-remediation activities related to their stewardship (e.g. inspection, monitoring, maintenance, corrective measures).

Much has already been achieved, as a result of both experience gained from remediation already carried out with third-party support, and activities dedicated specifically to capacity-building and regional cooperation. The latter include:

- Training under the auspices of ROSATOM’s Central Institute for Continuing Education and Training (ROSATOM-CICE&T) [24] and the Training and Tutoring Initiative implemented under the EU’s INSC [25];
- Identifying gaps in legislative and regulatory frameworks, filling identified gaps in some areas and/or making recommendations on how they may be filled in others [26, 27];
- Designing a regional watershed monitoring and early warning system and related analytic facilities and capabilities [27];
- The engagement of interested parties [28].

An agreement among countries within the CIS to further harmonize the legal and regulatory basis (e.g. regulations, assessing compliance, standardization, accreditation, metrology) for ensuring safety in the use of nuclear energy for peaceful purposes was signed in 2017 [29]. This agreement, which entered into force on 28 November 2017, makes an important contribution to further capacity-building and harmonization of remediation of uranium legacy sites in the region.

The existence of sound and complete regulatory frameworks, and site owners and regulatory authorities who are well informed and knowledgeable, will provide assurance that any remediation will be well conceived, sustainable and continue to address national and regional needs and priorities. The Strategic Master Plan focuses on supporting further capacity-building and regional cooperation in the following areas:

- Further development or refinement of national concepts, strategies and plans for environmental remediation (including post-remediation activities) by site owners and other interested parties;
- Continued training of site owners and regulatory authorities in the environmental remediation of ULS (including post-remediation activities);
- Completion of legislative and regulatory frameworks;
- Support for regulatory authorities in evaluating and regulating the safety of proposed remediation at all stages in the process, including the planning, implementation and post-remediation phases, and the development and use of an integrated management system for this purpose;
- Improving arrangements for the monitoring and early notification of an emergency or accident at a ULS that may have transboundary consequences;
- Further development and implementation of a common information system for exchange of information on uranium legacy sites within the affected Member States;
Further enhancement of cooperation between site owners in Central Asia (and likewise between regulatory authorities), in order to achieve greater critical mass within the region and make the best use of limited skills and knowledge at the national level in planning and undertaking remediation and regulating its safety;

Engagement with and better provision of information to interested parties, including those living and working in the affected areas.

The extent and nature of support for further capacity-building and regional cooperation to be provided in the Plan will enable site owners and regulatory authorities, within the next decade, to act in a largely autonomous manner when developing future remediation and post-remediation plans, regulating the safety of the sites and engaging with interested parties.

3.4.1 Further development of national concepts, strategies and plans for environmental remediation

Well-conceived, practicable, transparent and broadly agreed national concepts, strategies and plans for environmental remediation and post-remediation activities are essential for their successful implementation and acceptance by affected communities, as well as to assure third parties and donors that any support they may provide will be appropriately used.

Concepts or strategies for the environmental remediation of uranium legacy sites, together with plans for their implementation, are at varying stages of development in the countries concerned:

- Tajikistan issued its national concept for remediation of ULS in 2014 [10] and has since developed a programme [16] for realizing the concept;
- Kyrgyzstan developed a comprehensive programme in 2005 that identified sites containing tailings or waste dumps that were judged to be priorities for remediation [8]; some refinement of these priorities has since taken place, reflecting changed circumstances and more detailed investigations.
- Kyrgyzstan is developing a policy and strategy for the management and remediation of radioactive wastes located in dumps and tailings; and this was scheduled to be submitted to the Government by the end of 2017 (item 5 of the Action Plan on Managing Issues in the Field of Radiation Safety of the Kyrgyz Republic [30]).

This Strategic Master Plan has been developed, in part, to compensate for the absence of fully developed strategies and plans at a national level in all Central Asian Member States.

In principle, the Plan should be based on and fully embody the national strategies and plans of Kyrgyzstan, Tajikistan and Uzbekistan, integrating them in a coherent manner within a broader regional context, exploiting synergies and benefiting from regional cooperation where possible. In practice, this was not possible owing to the fact that strategies and plans in some Member States are still under development, and the possibility that they were not all developed on a common methodological basis (for example for assessing health and environmental risks, establishing priorities for environmental remediation and evaluating remediation options).

Nonetheless, the development of the Plan has taken account of national strategies and plans in their current form or forms, insofar as this was practicable. The Plan will need to be updated in response to changes or further development of national strategies and plans.

In this context, particular attention should be paid to ensuring coherence between the strategies and plans of each Member State (i.e. in terms of the methodological basis on
which they were derived), otherwise it will be difficult to make informed or reliable judgements in this Plan on the relative priority to be accorded to the remediation of sites by each Government. Support being provided under the auspices of the CIS Nuclear Commission to develop national waste management strategies in accordance with agreed principles (ideally a common strategy) in all CIS Member States [31] will help to ensure greater coherence between national strategies and plans.

The current focus in Kyrgyzstan, Tajikistan and Uzbekistan is on the remediation of objects or sites judged to present the greatest risk, or to be priorities for remediation when account is taken of other, broader considerations. There would, however, be merit in embedding these currently very focused plans within a more holistic approach or strategy that addresses remediation of a site or wider industrial complex as a whole (e.g. the multiple sites at Buston (formerly Chkalovsk) in Tajikistan).

Undue focus on the remediation of individual high risk objects (or individual sites within a wider industrial complex), without addressing the wider whole, may lead to suboptimal technical solutions and will be less likely to gain wide public support and acceptance. A more holistic approach that, in addition, sets out tangible, parallel measures to improve socioeconomic conditions, health care and amenity value would also encourage greater public support and acceptance. Similarly, there may be merit in national strategies and plans encompassing the remediation of all objects within a given legacy site or industrial complex, irrespective of the origin or nature of the risk (e.g. radioactive, chemical). The plans for remediating sites contaminated by radioactive material — the main focus of this Strategic Master Plan — would then be a sub-part of this larger whole.

The Plan contains a provision for supporting the further development of national strategies and plans for environmental remediation of uranium legacy sites in two main contexts: first, to ensure that they are fully developed and internally consistent (i.e. developed on a common methodological basis), and remain fully compatible with this Plan; and second, to prepare and disseminate them in a form or forms that are more amenable and readily understandable to interested parties (such as affected communities and their political representatives, opinion formers). The support is scheduled to begin in 2018 and last for two years. The need for, and nature of, further support will be evaluated at the end of this period in the light of experience gained.

3.4.2 Continuing training

Dedicated training courses for uranium legacy site owners and regulatory authorities on the remediation of ULS are being held by ROSATOM-CICE&T in cooperation with the IAEA [24]. Two courses have already been held and a further eight have been scheduled between 2017 and 2019 under the auspices of an IAEA Technical Cooperation (TC) regional project. Subject to need, the courses may continue beyond 2019 with further support from the IAEA’s TC programme and/or the CIS Programme.

Under the auspices of the CIS Nuclear Commission Basic Organization for Education (CISBOE), established in 2015 to promote collaboration and exploit synergies between universities in CIS Member States, a master’s degree training course on ULS remediation is being developed by the Kyrgyz Institute of Biology and Soil Science. Implementing the course will depend on the availability of funds.

The EU’s INSC Training and Tutoring Initiative [25] also provides a broad range of training in nuclear and radiation safety (including on remediation of uranium mines and mills), as well as more customized tutoring on a diverse range of topics. The training and tutoring is directed at regulatory authorities and their technical support organizations (TSO), and is expected to continue until at least 2020.
Both Tajikistan (in its programme for realizing the national concept for remediation [16]) and Kyrgyzstan (in its action plan for managing radiation safety issues [30]) recognize the importance of continuing training for both the owners of legacy sites and the regulatory authorities, and make provision for this.

The Strategic Master Plan foresees a formal review in the fourth quarter of 2019 of the need for continued training and tutoring on remediation of ULS, and of the form or forms that it should take. Two aspects will receive particular attention in this review:

• The development by regulatory authorities of more systematic and sustainable frameworks or plans for training new staff and maintaining knowledge and skills among existing personnel, particularly in the context of high staff turnover;
• The benefit of training at a regional level where this is practicable, cost-effective and compatible with training objectives, to take advantage of economies of scale and critical mass. The establishment, with support from the Embassy of the United States in Tajikistan, of a regional training centre on radiation safety and security at the NRSA may have an important role to play in this respect.29

Subject to the outcome of this review, support for further dedicated training courses and/or customized tutoring beyond 2020 may be provided, and the scope and content of training or tutoring revised as necessary.

3.4.3 Completing the legislative and regulatory frameworks

The Norwegian Radiation Protection Authority (NRPA) has been actively cooperating with Central Asian Member States since 2008, assisting in particular in the review and/or development of regulations in the areas of radiation protection, radioactive waste management and remediation [26]. National regulatory frameworks have been upgraded in response to identified needs, and numerous laws, regulations, standards and guidance have been developed and/or brought into force.

A comprehensive evaluation is being made of the legislative and regulatory frameworks in Kyrgyzstan with support from the EU’s INSC [27]; any significant gaps that remain will be identified and recommendations made on how they may be filled.

An agreement among CIS Member States came into force in 2017 to further harmonize the legal and regulatory basis for ensuring safety in the use of nuclear energy for peaceful purposes [29]. Among other things, this will result in the adoption of ‘state of the art’ regulatory and legislative frameworks and in greater harmonization in regulating the remediation of uranium legacy sites in the CIS.30 The development of national waste management strategies in accordance with agreed principles, under the auspices of the CIS Nuclear Commission (see Section 3.4.1), will further enhance the legislative and regulatory frameworks [31].

29 Support is also being provided, under the auspices of the IAEA TC programme, for instructor training and supply of equipment; further support from international donors is being sought for the construction of a new radiochemical laboratory and upgrading of a spectrometry laboratory, at a cost of approximately €300 000.

30 The following requirements or guidelines are being developed in the Russian Federation: ‘Hygienic requirements for the rehabilitation of facilities and territories contaminated by man-made and natural radionuclides as a result of past activities of nuclear and non-nuclear industries’ (fourth quarter of 2017); ‘Guidelines for the organization and conduct of radiation surveys of sites and areas contaminated with anthropogenic radionuclides as a result of past activities of nuclear and non-nuclear industries, after their rehabilitation’ (third quarter of 2018); ‘Guidelines for the assessment of radiation doses in the population caused by facilities and territories contaminated by man-made and natural radionuclides as a result of past activities of nuclear and non-nuclear industries’ (fourth quarter of 2019). These documents are being developed in accordance with the requirements and standards of the IAEA and the International Commission on Radiological Protection (ICRP), and take account of best practice in the remediation of contaminated areas in countries including the Russian Federation, Kyrgyzstan and Tajikistan. The documents are expected to be submitted for peer review by the IAEA and provided as basic guidance documents for use in the CIS.
The Plan foresees a decision in the fourth quarter of 2018 on if and when it will be necessary to provide further support to fill any gaps identified in the national frameworks, and where appropriate, achieve greater harmonization across the region.

3.4.4 Supporting regulatory authorities and other governmental organizations in implementing the Strategic Master Plan

Support will be provided to regulatory authorities and other governmental organizations in implementing the Strategic Master Plan, particularly in its early stages before they develop sufficient knowledge and experience to act in a fully autonomous manner. Support will be provided in three main areas:

- To those Contracting Parties that have yet to fulfil their obligations under the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management [32], particularly in the preparation and submission of national reports to review meetings;
- To regulatory authorities in enhancing their capacities for reviewing and approving (licensing) applications to carry out remediation, and ensuring the safety and environmental acceptability of all stages of the remediation process (particularly the long-term post-remediation phase);
- To owners of uranium legacy sites in developing sustainable arrangements for the stewardship of remediated sites (e.g. inspection, monitoring, maintenance, corrective actions).

While Kyrgyzstan and Uzbekistan are Contracting Parties to the Joint Convention (since 2007 and 2009, respectively), neither appears to have yet submitted national reports to biennial review meetings, as required by the Convention. Support will be provided to these Contracting Parties in preparing reports to be submitted to the next review meeting, scheduled for 2018.

Over the next decade, regulatory authorities in Kyrgyzstan, Tajikistan and Uzbekistan will need to evaluate and approve or license an increasing number of applications to carry out remediation of uranium legacy sites. This will be required at various stages in the process, particularly at the planning stage, during the remediation itself (including continuing oversight and inspections) and in the post-remediation phase.

At least initially, resources and skills within the regulatory authorities may not be sufficient to carry out these evaluations and approvals in a sufficiently timely and/or rigorous and robust manner. This poses a risk of project delays and/or increased costs, were any safety issues to be identified after remediation had begun.

To minimize such risks, the Plan includes a provision to support regulatory authorities throughout the full life cycle of activities involved in regulating remediation activities. The Plan foresees that this support will continue for the next five years, after which the need will be reassessed.

This will be complemented by support for the development of an integrated management system [33, 34] for use by the relevant regulatory authorities in their assessment and verification of safety. This system will enable a more systematic and sustainable approach to regulating safety, and once operational, will reduce the need for third-party support in future. Among other issues, it will address the decision making process for safety reviews and the licensing of remediation of legacy sites, as well as procedures for the following:

- Issuing, amending, suspending, revoking and terminating licences;
- Reviewing and assessing all phases of remediating a ULS (including post-remediation arrangements);
• Inspection and enforcement, including the conduct of inspections and preparing inspection reports;
• Issue tracking;
• Resource management;
• Training.

Tried and tested methods for providing effective support to regulatory authorities in regulating the implementation of nuclear safety projects have been developed and used in the EU’s TACIS programme [35], in the EBRD’s Chernobyl Shelter Fund [36] and in the EBRD’s Northern Dimension Environmental Partnership [37]. Account will be taken of this experience in determining the approach to be adopted in implementing the Strategic Master Plan. Support is likely to be provided on a project-by-project or country-by-country basis, depending on which is the most practicable, taking account of local circumstances. The support given to regulatory authorities will provide added assurance that remediation will proceed in a timely, safe and sustainable manner, and in line with good international practice.

Given the imminent start of a number of major remediation activities in the region, the Plan foresees a decision at the earliest opportunity on the nature and form of support to be given to national authorities in their regulation of remediation.

While the current focus is on remediation of uranium legacy sites, increasing attention will need to be given in future to post-remediation activities, in order to sustain the improvements made. The scope and nature of arrangements and related activities for ensuring the continuing effectiveness of the remediation undertaken, including continuing compliance with regulatory requirements, will be specified in any well-conceived project.

Arrangements will include provisions for continuing inspection, monitoring, maintenance and corrective measures at each remediated site, with sustainable stewardship being the key aim. Site owners will need to develop and sustain the capacity (in terms of knowledge, expertise and resources, both human and financial) to exercise stewardship of their remediated sites. The Plan includes a provision to support owners in developing the necessary capacity for post-remediation activities, and foresees a decision on its scope and content31 in the third quarter of 2018.

3.4.5 Early warning and notification of emergencies or accidents at ULS with potential transboundary consequences

The Convention on Early Notification of a Nuclear Accident [38] was established following the Chernobyl accident in 1986. It provides a robust, effective and well-tested means for a Member State to notify neighbouring countries and the IAEA of the potential for transboundary consequences following a radiological or nuclear emergency or accident on its territory. Accidents or emergencies at uranium legacy sites with potential transboundary consequences fall within the scope and provisions of the Convention.

Given the proximity of several ULS in Central Asia to the borders of a neighbouring country, in the event of an accident or emergency at a ULS there is a significant risk of radioactive material being dispersed across national borders via rivers and/or other water bodies. In such circumstances, it would be prudent to use the provisions of the Convention to provide early notification to neighbouring countries. However, Kyrgyzstan and Uzbekistan have yet to accede to or ratify the Convention.

31 Under certain circumstances, this may include a contingency for supporting post-remediation measures where the lack of national resources (human or financial) might prejudice the continuing effectiveness of any remediation that had been undertaken with third party support; however, the expectation is that the respective country shall be responsible for ensuring the proper implementation of specified post-remediation activities.
In the absence of other provisions for notifying neighbouring countries in a reliable and timely manner about an emergency or accident at a ULS with potential transboundary consequences, Kyrgyzstan and Uzbekistan will be encouraged to take steps to accede to the Convention at the earliest opportunity. Support will be provided to Kyrgyzstan and Uzbekistan in acceding to the Convention, and in the practical application of its provisions. Accession by these Member States is foreseen in the Plan by the second quarter of 2018, with practical application of its provisions being achieved by the fourth quarter of that year.

Early notification of an emergency or accident at a ULS with potential transboundary consequences may be triggered in various ways: for example, by the threatened or observed release of a large amount of tailings into a river or other water body as a result of dam failure, mudslides or earthquakes, or the monitored elevated levels of radioactive material in the environment.

Monitoring, combined with models to predict the downstream dispersion of any material released into a river system, will provide more informed and reliable estimates of the potential consequences of any release, how they may develop over time and how they may be mitigated by applying countermeasures. Such estimates will be essential inputs to the management of any accidental release, both within the country where the accident might occur and beyond its national boundaries.

UNDP, with financial support from the Russian Federation, has undertaken a feasibility study for establishing a unified monitoring system in Kyrgyzstan for the comprehensive monitoring and forecasting of disasters. Based on the outcome of this feasibility study, UNDP is supporting the Kyrgyz Government in installing the monitoring system for a broad range of potential emergencies. Phase I (2017-18) comprises the installation of core elements of the system; phase II (2019-21) comprises full-scale operation of the core elements; and phase III (2022-25) comprises extension of the system to other elements.

Unless there were strong arguments to the contrary, any monitoring system for uranium legacy sites should be compatible and integrated within this national system. It could then provide early warning of any release of radioactive material to river systems within Kyrgyzstan in amounts that may have significant transboundary consequences. Neighbouring countries may wish to exploit experience gained in the development and use of this unified system in Kyrgyzstan.

With support from the EU's INSC, an integrated regional watershed monitoring system is being designed for the following purposes:

- Routine environmental monitoring of ULS;
- Providing early warning of any emergency in which contaminants may be released to the watershed;
- Estimating the impact of any release, especially where it may have cross-border implications;
- Evaluating how any impact can be mitigated by timely and effective countermeasures.

It is envisaged that monitoring stations and laboratories with analytic facilities for measuring environmental samples will be installed or upgraded in Kyrgyzstan, Tajikistan and Uzbekistan, with appropriate interfaces being established with existing national or regional systems (e.g. the unified system for comprehensive monitoring in Kyrgyzstan – see above). Training would be provided in the use of any equipment provided. Models for predicting the dispersion of any contaminant released to the watershed would also be an essential part of the system.

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33 In accordance with Kyrgyzstan’s ‘Unified Information Management System for Disaster and Crises Settings (UIMS)."
The design of the system will be completed by the second quarter of 2018 in a form suitable for tendering the supply of its components.

The EU’s INSC programme envisages that the supply and installation of the regional watershed monitoring system, including an enhanced laboratory system, could be implemented in the time frame 2018–2020. The establishment of national monitoring networks and their integration into a regional system will enhance confidence and trust among potentially affected populations that proper arrangements are in place to ensure their protection, and facilitate a more informed and coherent intergovernmental response to any emergency with cross-border implications.

3.4.6 Regional cooperation

Enhancing cooperation between Central Asian Member States in the environmental remediation of uranium legacy sites, and in regulating their safety, would have several benefits. It would achieve greater critical mass, make best use of skills, knowledge and experience in the region, and promote the adoption of more common standards and approaches to remediation and the regulation of safety.

A number of mechanisms or networks already exist to facilitate cooperation between owners of ULS, and between those responsible for regulating their remediation. The following four are of particular relevance in the present context:

- Coordination Group for Uranium Legacy Sites (CGULS);
- International Forum on the Regulatory Supervision of Legacy Sites (RSLS) [40];
- European and Central Asian Safety Network (EuCAS) [41];
- International Network for Environmental Management and Remediation of Radiologically Contaminated Sites (ENVIRONET) [42].

CGULS was established in 2012 to promote cooperation between IAEA Member States affected by uranium legacy sites and national and international organizations involved in the management, remediation or regulatory oversight of ULS, by providing a forum for information exchange and provision of technical advice, and coordinating the actions of members to maximize synergies and avoid duplication of effort.

RSLS was established by the IAEA in 2010 and promotes the effective and efficient regulatory supervision of legacy sites, consistent with IAEA standards and good practice. It operates mainly through a series of technical meetings and workshops at which experience is exchanged on good and best practices, lessons learned in the management of ULS, the conduct of safety and environmental assessments, licensing, inspection, compliance monitoring and enforcement, training, etc.

EuCAS is a new network established by the IAEA in September 2016. It aims to strengthen nuclear and radiation safety in Europe and Central Asia by facilitating dialogue and knowledge exchange between Member States in these regions. Its initial focus will be the management of radioactive waste, but environmental remediation has been identified as a future activity.

ENVIRONET was established in 2010 by the IAEA’s Department of Nuclear Energy, with the following aims:

- Coordinate support to organizations and Member States by making available the relevant skills, knowledge, managerial approaches and expertise related to environmental management and remediation;
- Offer training and demonstration activities;
- Facilitate sharing and exchanging knowledge and good practice;
• Provide a forum in which expert advice and technical guidance may be given.

The focus of ENVIRONET is on owners of sites who are responsible for remediation. A number of past and/or ongoing activities of the network are directly relevant to remediation of ULS.

The Central Asian Member States should leverage their participation in CGULS, RSLS, EuCAS and ENVIRONET to further enhance and deepen the transfer and sharing of knowledge and experience on the remediation of ULS. This could be achieved through informal gatherings in the margins of meetings of the above groups or networks, or through more formal mechanisms such as the establishment of a subgroup or groups specifically for this purpose.

A common information system for the exchange of information on uranium legacy sites in Central Asia has also been developed under the auspices of CGULS. This system will be further developed and maintained by the CGULS secretariat. Its active use by the Central Asian Member States will be a further mechanism for enhancing regional cooperation.

Regional cooperation will be further enhanced and/or facilitated as a result of the establishment of a regional training centre at NRSA in Tajikistan (see Section 3.4.2) and the coming into force in 2017 of a new agreement among CIS Member States to further harmonize the legal and regulatory basis for ensuring safety in the use of nuclear energy for peaceful purposes (see Section 3.4.3).

3.4.7 Engagement of interested parties

A project to engage with and better inform a broad range of interested parties on the environmental remediation of uranium legacy sites is being undertaken within the Environment and Security Initiative (ENVSEC) with the participation of UNDP, OSCE and UNEP and with support from the EU's INSC [28]. This project is being implemented in Kyrgyzstan and Tajikistan and is scheduled for completion in the first quarter of 2018.

Existing OSCE-supported Aarhus Centres34 in Osh (Kyrgyzstan) and Khujand (Tajikistan) are being strengthened and three new public environmental information centres are being established in the vicinities of the Min-Kush, Shekaftar and Mailuu-Suu sites in Kyrgyzstan. The activities of these centres include awareness-raising, public outreach, dissemination of information on ULS and how they may be safely remediated, and on any planned or ongoing remediation in the area. Capacities are also being developed to ensure the sustainability of engagement with interested parties within the EIA of any proposed remediation of a uranium legacy site.

Although discussions are ongoing on extending the ENVSEC project for a further two years beyond 2018, the Aarhus Centres and environmental information centres will need to continue in operation long after its likely completion, and in principle until the remediation of uranium legacy sites in each area is complete and post-remediation measures established.

The centres will provide a continuing source of reliable and trustworthy information for all interested parties (e.g. local and regional communities, their political representatives, local authorities, opinion formers). This will contribute to more informed decision making and enhanced trust and confidence within local communities in measures being taken to remediate ULS in their area, and enhance their wellbeing.

The continued operation of these centres will require funding. If this cannot be achieved with local, regional or national funding, or with continuing support from the OSCE and United

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34 The Aarhus Centres provide platforms to engage citizens, governments and the private sector in a dialogue on environmental challenges. They assist governments in implementing the Aarhus Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters, and assist citizens in understanding and exercising their rights under the Convention (see https://aarhus.osce.org/).
Nations bodies, other mechanisms will need to be evaluated as part of future revisions of the Plan. Some contribution could reasonably be anticipated from projects undertaking remediation work, particularly as the centres have demonstrated the potential to play an important role in informing local communities and gaining their trust and support as work proceeds.

Due account will be taken of the scope and content of any extension to the ongoing ENVSEC project when making the decision on whether to fund the continued operation of the two Aarhus Centres, and if so by what mechanism/s.

### 3.4.8 Other support activities

A number of other support activities for Kyrgyzstan and Tajikistan have been included in the CIS Programme for the period 2017–2023. These comprise the development of:

- Improved monitoring of the environment and the population;
- An improved system for ensuring radiation safety;
- A demographic and medical register for populations living in the vicinity of ULS;
- Training for those involved in the management of remediation projects or programmes.

Some €1.2 million has been budgeted by the CIS Programme for these activities (in addition to about €100 000 foreseen for continuing training of site owners and regulatory authorities – see Section 3.4.2).

Support for capacity-building on remediation of uranium legacy sites is also being provided in an IAEA Technical Cooperation project, RER9145, ‘Supporting Human Resource Capacity Building for Developing and Implementing Integrated Programmes for Remediation of the Areas Affected by Uranium Mining’.

This project aims to assist in resolving nuclear legacy problems in areas affected by uranium mining in Europe and Central Asia, and to develop competence and capabilities for managing remediation projects and programmes and for operating and monitoring ULS.

### 3.5 The elements of the Plan, milestones and costs

The preceding sections presented the status and/or outcomes of evaluations of options for remediating each site or object (or at least those judged to present a high or medium risk). Evaluations have been completed for several sites, and are ongoing for many others.

For those sites or objects where evaluations have been completed, ‘optimal’ or preferred options for their environmental remediation have been identified and costed (see Appendix B); documentation (including safety assessments) is available as a basis for tendering the proposed remediation work. Decisions have already been made to begin remediation of a few sites or objects, and are pending on a number of others, subject to available funding.

The elements of the overall programme for remediating ULS in Central Asia are set out in Figures 2.1 and 2.2. The various steps, along with their timing, in developing ‘implementation ready’ projects for remediation are indicated in Figure 2.1. Where decisions have been made to proceed with remediation, the timing of the remediation work is shown. In other cases, milestones are provided for when decisions are to be taken on if and when ‘implementation ready’ projects are to be initiated; and if and when a systematic and comprehensive evaluation of risks and remediation options is to be undertaken for those legacy sites yet to be fully evaluated. Figure 2.2 provides a similar schedule for capacity-building, regional cooperation and institutional and organizational arrangements.
Figure 2.1 Elements of the programme for environmental remediation activities

<table>
<thead>
<tr>
<th>Site</th>
<th>Object</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kyrgyzstan</td>
<td>Tailings piles</td>
<td>Site/object evaluation (UNSC) Peer review Detailed specification for remediation Post-remediation</td>
</tr>
<tr>
<td>Min-Kush</td>
<td>Tailings piles</td>
<td>Site/object evaluation (CIS) Peer review Detailed specification for remediation Remediation Regulatory oversight/approval Post-remediation</td>
</tr>
<tr>
<td></td>
<td>Shafts, adits, waste rock dumps</td>
<td>Site/object evaluation (NSC) Peer review Detailed specification for remediation Regulatory approval Decision if/when to fund/remediate</td>
</tr>
<tr>
<td></td>
<td>Shafts, adits, waste rock dumps, buildings</td>
<td>Site/object evaluation (NSC) Peer review Detailed specification for remediation Regulatory approval Decision if/when to fund/remediate</td>
</tr>
<tr>
<td>Tekhtaar</td>
<td>Tailings piles</td>
<td>Partial remediation of tailings (World Bank)</td>
</tr>
<tr>
<td>Malu-Suu</td>
<td>Shafts, adits, waste rock dumps, tailings</td>
<td>Site/object evaluation (NSC) Peer review Detailed specification for remediation Remediation Regulatory oversight/approval Post-remediation</td>
</tr>
<tr>
<td>Kadi-Say</td>
<td>Tailings piles</td>
<td>Site/object evaluation (CIS) Detailed specification for remediation Remediation Regulatory oversight/approval Post-remediation</td>
</tr>
<tr>
<td>Kara Balla</td>
<td>Tailings</td>
<td>Decision on continued inclusion of site within SMP Decision if/when to carry out evaluation</td>
</tr>
<tr>
<td>Kyzyl-Djar</td>
<td>Waste dump</td>
<td>Decision if/when to carry out evaluation</td>
</tr>
<tr>
<td>Tuyo-Moyun</td>
<td>Waste dump</td>
<td>Decision if/when to carry out evaluation</td>
</tr>
</tbody>
</table>
Figure 2.2 Elements of the programme for capacity-building and regional cooperation, and for institutional and organizational arrangements

<table>
<thead>
<tr>
<th>Topic</th>
<th>Sub-topic</th>
<th>Activity</th>
</tr>
</thead>
</table>
| **Capacity building and regional cooperation** | National strategies and plans for remediation | Achieve consistency with SMP
Develop a more holistic approach |
| | Training and tutoring | ROSATOM-CEC/CT: Remediation of ULs
EUNESCO Training and Tutoring Initiative
Training in project management (CIS)
Develop a course on ULs remediation
Establish a training centre in Kazakhstan
Develop systematic and more sustainable approach to training |
| | Legislative and regulatory frameworks | Regulatory threat assessment (RPTRA)
Upgrading regulatory framework (RPTRA)
Evaluation of problems in Kyrgyzstan (EUNESCO)
Decision on transition to fill gaps in regulatory frameworks |
| | Support to Regulatory Authorities and other governmental organizations | Preparation of a national report for the meetings of Joint Convention
Decision on the sustainability of support for evaluating/approving remediation projects
Evaluating and approving remediation projects
Decision on the need to extend duration of support |
| | Support to ULS owners in building capacity for and undertaking post-remediation activities | Decision on the nature, scope and timing of support |
| | **Early warning and notification of emergency or accident** | National monitoring system for all emergencies in Kyrgyzstan (UN)/ |
Kyrgyzstan and Uzbekistan accede to IAEA Early Notification Convention
Application of Convention provisions
Design of regional real-time monitoring system (WMDS) (NIS)
Decision on the transition to implement WMDS (NIS) |
| | **Engagement of interested parties and socioeconomic development** | ENVIS project (UN)/
Decision on the need for continuous operation of centres
Implementation of support for socioeconomic development (UNEP/UNDP) |
| | **Regional cooperation** | Agreement on harmonization of legal and regulatory frameworks in CIS
Leverage participation in CIGUS, ISS, IAEA, ENVIRONET |
CIGUS implementation system for ULs
Regional training centre established in Tajikistan |
| | **Other activities** | Development of demographic-geological registers in areas around ULs (CIS)
Implementation of monitoring of health/environment |
| **Institutional and organizational arrangements** | Baseline document | Assessment and way forward for Legacy Uranium Production Sites in Central Asia |
CGIUS | Established
Primary meetings |
SMP - approval and endorsement | Approved by Kyrgyzstan, Tajikistan and Uzbekistan
Endorsement by ERA Assembly
Consideration and approval by CIS |
Care Group of CIGUS | Monitoring implementation of SMP
Periodic review/update of SMP |
EBRD ERA | ERA established
ERA - Assembly meetings
High Level Direct/Delegated Conference
Establishment of Project Management Unit (PMU)
Framework Agreements |
CIS Programme | Concept developed
Programme approved
Phase I: Evaluation of high risk ULs
Phase II: Remediation of high risk sites |
CISERA Coordination | Common methodology for evaluating risks and remediation options
Mechanism to coordinate funding and implementation of remediation |
Coordination with UNEP, etc | Mechanisms for leveraging remediation projects to achieve sustainable socio-economic improvements |

* Milestone - decision, etc
# Milestone - meeting/event
Table 4 summarizes the following:

- Ongoing environmental remediation projects;
- Remediation projects that have been developed, costed and documented in a form suitable for tendering;
- Remediation projects that are under preparation (i.e. evaluation of risks and remediation options) and likely to be completed within the next few years.

Remediation is already under way at Charkesar-2 (with national funding), at the tailings ponds at Min-Kush and Kadji-Say (with support from the CIS Programme), and with the design and engineering of a water treatment facility (WTF) for mine waters at Istiklol (formerly Taboshar) with support from the EU’s INSC.

Remediation projects at four sites — Min-Kush (excluding tailings), Shekaftar, Charkesar-1 and Yangiabad — are ready for tendering subject to the availability of funds; the overall cost of remediating these sites/objects is about €15 million.

Remediation projects (i.e. evaluations of risks and remediation options) are under preparation at Yellow Hill, tailings ponds 1–4 and other objects at Istiklol; the tailings pond at Degmay; treatment of mine water at Khujand, and possibly Karta 1–9 at Buston (formerly Chkalovsk) in Tajikistan; and all objects at Mailuu-Suu in Kyrgyzstan. These projects are expected to be ready for tendering, subject to the availability of funding, in 2018, with the exception of Mailuu-Suu (2020).

Systematic and comprehensive evaluations of the risks and remediation options have yet to be undertaken for three of the legacy sites listed in Table 1, namely Kara Balta, Khujand and Adrasman (see Table 4.4); a confirmatory independent assessment may be needed for Gafurov. When these are made, a complete portfolio of ‘implementation ready’ remediation projects for all uranium legacy sites35 in Kyrgyzstan, Tajikistan and Uzbekistan will be available. Decisions on undertaking remediation at the various sites, and on their relative priorities, can then be made on a more informed and systematic basis.

Milestones in the Plan are the following decisions:

- In the third quarter of 2017: on if and when to undertake a systematic and comprehensive evaluation of risks and remediation options for the Adrasman site;
- In the third quarter of 2017: on if and when to fund/remediate Shekaftar and other objects at Min-Kush (excluding tailings piles), taking account of the availability of funds and competing priorities;
- In the first quarter of 2018: on if and when to fund/remediate Charkesar-1 and Yangiabad, taking account of the availability of funds and competing priorities;
- In mid-2018: on whether, depending on its legal status, Kara Balta remains within the Plan, and, if so, when to undertake systematic and comprehensive evaluations of risks and options for its remediation;
- In the third quarter of 2018: on if and when to fund/remediate Degmay and other objects at Istiklol (excluding ‘yellow hill’ and tailings ponds 1–4);
- In the fourth quarter of 2018: on if and when to fund/remediate Yellow Hill’ and tailings ponds 1–4 at Istiklol;
- In the fourth quarter of 2018: on if and when to undertake a systematic and comprehensive evaluation of risks and remediation options for sites/objects on the Buston industrial complex that have yet to be fully evaluated (i.e. Khujand), and an independent evaluation to confirm that remediation already carried out at Gafurov is sufficient;
- In the third quarter of 2019: on if and when to fund/remediate Mailuu-Suu, taking account of the availability of funds and competing priorities.

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35 Except for Kyzyl-Djar and Tuya-Moyun, which are not priorities for remediation and will only be addressed when remediation of priority sites has been completed (probably not before 2028).
Summary of remediation projects being implemented, projects ready for tendering and those under preparation

Table 4.1 Remediation projects being implemented

<table>
<thead>
<tr>
<th>Site/object</th>
<th>Cost (millions of euros)</th>
<th>Timescale for remediation</th>
<th>Funding</th>
<th>Nature of remediation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charkesar-2 (Uzbekistan)</td>
<td></td>
<td></td>
<td>Uzbekistan</td>
<td>Improved covering of waste dumps</td>
</tr>
<tr>
<td>Min-Kush (tailings) (Kyrgyzstan)</td>
<td>23</td>
<td>2017–2022</td>
<td>CIS</td>
<td>Relocation of Tuyuk-Suu and Taldy-Bulak tailings ponds to Dalnee and covering of Dalnee tailings</td>
</tr>
<tr>
<td>Kadjji-Say (Kyrgyzstan)</td>
<td>1.5</td>
<td>2017–2018</td>
<td>CIS</td>
<td>Further in situ remediation of tailings including drainage channel to divert runoff and prevent erosion of sides of tailings pile</td>
</tr>
<tr>
<td>Degmay (Tajikistan)</td>
<td>0.3</td>
<td>2015–2018</td>
<td>Tajikistan</td>
<td>Covering of 30% of tailings area (about 30 ha) as an intermediate and short-term measure to reduce exposure to resuspended tailings dust, pending full remediation</td>
</tr>
<tr>
<td>Istiklol (mine waters) (Tajikistan)</td>
<td>2.5</td>
<td>2016–2018</td>
<td>EU INSC</td>
<td>Design and construction of water treatment facility for discharged mine waters</td>
</tr>
</tbody>
</table>

Table 4.2 Remediation projects ready for tendering/implementation (subject to availability of funding)

<table>
<thead>
<tr>
<th>Site/object</th>
<th>Cost (millions of euros)</th>
<th>Expected duration of remediation works (years)</th>
<th>Project developed with support from</th>
<th>Nature of remediation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min-Kush (excluding tailings) (Kyrgyzstan)</td>
<td>4.1</td>
<td>1–2</td>
<td>EU INSC</td>
<td>Closure of seven shafts/adits and seven sinkholes; demolition of two bunkers and a mill with in situ disposal; drainage, discharge or diversion of water at three waste rock dumps</td>
</tr>
<tr>
<td>Shekaftar (Kyrgyzstan)</td>
<td>3.5</td>
<td>2</td>
<td>EU INSC</td>
<td>Closure of six shafts and relocation of five waste rock dumps to more remote location</td>
</tr>
<tr>
<td>Charkesar-1 (Uzbekistan)</td>
<td>0.6</td>
<td>3</td>
<td>EU INSC</td>
<td>Closure of two shafts, one adit and five sinkholes; demolition of abandoned buildings; cleanup of small heaps of leached ore</td>
</tr>
<tr>
<td>Yangiabad (Uzbekistan)</td>
<td>6.3</td>
<td>3</td>
<td>EU INSC</td>
<td>Closure of four shafts, 23 adits and eight sinkholes; demolition of abandoned buildings and processing facilities; discharge channels for surface water; river bank protection; relocation of several waste rock dumps; and a storage cell for contaminated material</td>
</tr>
</tbody>
</table>

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36 All costs quoted in Euros €, irrespective of whether they were initially estimated in local or other currencies. The following exchange rates (January 2017) were adopted for currency conversion: 8.46 Tajikistani somoni/€; 74.6 Kyrgyzstani som/€; RUB 63.98/€; and US$1.073/€.
Table 4.3 Remediation projects under preparation (i.e. systematic and comprehensive evaluation of risks and remediation options)

<table>
<thead>
<tr>
<th>Site/object</th>
<th>Ready for tendering and implementation (subject to outcome)</th>
<th>Project being prepared with funding from</th>
<th>Scope of remediation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degmay (all)</td>
<td>2018</td>
<td>EU INSC</td>
<td>All objects presenting significant risk</td>
</tr>
<tr>
<td>(Tajikistan)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Istiklol (tailings)</td>
<td>2019</td>
<td>CIS</td>
<td>Re-contouring of ‘yellow hill’ and covering tailings piles 1–4</td>
</tr>
<tr>
<td>(Tajikistan)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Istiklol (other</td>
<td>2018</td>
<td>EU INSC</td>
<td>All objects presenting significant risk (excluding ‘yellow hill’ and tailings piles 1–4)</td>
</tr>
<tr>
<td>objects) (Tajikistan)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Khujand (Tajikistan)</td>
<td>2018</td>
<td>TJ</td>
<td>Recommissioning of water treatment facility for mine waters (purchase of new ion-exchange resins)</td>
</tr>
<tr>
<td>Buston (Karta 1–9)</td>
<td>2018</td>
<td>FSD</td>
<td>Karta 1–9 tailing dumps, industrial waste sites and ‘hot-spots’</td>
</tr>
<tr>
<td>(Tajikistan)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mailuu-Suu (all)</td>
<td>2019/20</td>
<td>EU INSC</td>
<td>All objects presenting significant risk</td>
</tr>
<tr>
<td>(Kyrgyzstan)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4.4 Legacy sites for which a systematic and comprehensive evaluation of risks and remediation options has yet to be made (or is not in the process of being made)37

<table>
<thead>
<tr>
<th>Site</th>
<th>Member State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kara Balta</td>
<td>Kyrgyzstan</td>
</tr>
<tr>
<td>Adrasman</td>
<td>Tajikistan</td>
</tr>
<tr>
<td>Khujand (objects other than mine water)</td>
<td>Tajikistan</td>
</tr>
</tbody>
</table>

Table 5. Summary of further support needed for capacity-building and regional cooperationa

<table>
<thead>
<tr>
<th>Activity</th>
<th>Duration</th>
<th>Indicative cost (millions of euros)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Further development of national strategies and plans for remediation</td>
<td>2018–2021</td>
<td>0.1</td>
</tr>
<tr>
<td>Continuing training and development of more systematic and sustainable</td>
<td>2018 onwards</td>
<td>0.3</td>
</tr>
<tr>
<td>training plans</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Completing legislative and regulatory frameworks</td>
<td>2019–2020</td>
<td>1</td>
</tr>
<tr>
<td>Supporting authorities in assessing and verifying safety (both during and post-remediation) and in developing and using a more systematic and sustainable approach in future (i.e. use of an integrated management system)</td>
<td>2018–2022 (and possibly beyond)</td>
<td>2</td>
</tr>
<tr>
<td>Early notification/warning and regional watershed monitoring system</td>
<td>2019–2022</td>
<td>2–3</td>
</tr>
<tr>
<td>Supporting ULS owners in building capacity for and undertaking post-remediation activities (e.g. sustainable stewardship including inspection, monitoring, maintenance, corrective action, etc.)</td>
<td>2018–2025 (and possibly beyond)</td>
<td>2.5</td>
</tr>
<tr>
<td>Engagement and better informing of interested parties</td>
<td>2018–2024</td>
<td>0.5</td>
</tr>
<tr>
<td>Other support activities (CIS Programme – see Section 3.4.8)</td>
<td>2017–2023</td>
<td>1</td>
</tr>
</tbody>
</table>

a. For perspective, Tajikistan, in its programme [16] for realizing its national concept for remediation, estimated the cost of further support for capacity building in the area of legislative and regulatory frameworks (activities covered by Section 3.4.3 and part of those in Section 3.4.2) to be about €500 000.

37 Evaluations may also need to made for Kyzyl-Djar and Tuya-Moyun, but will only be undertaken after remediation of priority sites has been completed (probably not before 2028).
Table 5 summarizes the main elements of the Plan for providing further support for capacity-building and regional cooperation; further detail is provided in Figures 2.1 and 2.2, where the timing and duration of the various activities are indicated along with milestones for decisions (including those for the development of institutional and organizational arrangements).

Further support for capacity-building and regional cooperation will be essential in achieving timely, effective and sustainable remediation of the various sites/objects. In the absence of such support, the (avoidable) risk of delays and enhanced costs while remediation is being carried out, owing to regulatory and/or public concerns, could be considerable.

3.5.1 Costs

3.5.1.1 Systematic and comprehensive evaluation of risks and environmental remediation options

Systematic and comprehensive evaluations of risks and remediation options have been, or are in the process of being, undertaken for nine of the twelve uranium legacy sites listed in Table 1. The costs of these studies amounted to about €12 million, of which about 80% has been provided from the EU’s INSC and the remainder from the CIS Programme. Systematic and comprehensive evaluations remain to be carried out for three sites — Kara Balta (subject to a decision on its legal status), Khujand and Adrasman — before determining how they should be remediated; the cost of these further evaluations is estimated to be around €5 million overall.

3.5.1.2 Environmental Remediation

Several estimates, of varying quality and rigour, have been made of the costs for environmental remediation of the uranium legacy sites. The more significant estimates comprise those made: in the baseline document [1]; in national concepts/strategies for remediation and/or action plans for their implementation [8–10, 16]; during IAEA missions to Kyrgyzstan in October 2016 [43] and to Tajikistan in March 2017 [49]; and in systematic and comprehensive evaluations of risks and remediation options carried out with support from the CIS Programme [20] and the EU’s INSC [18, 19, 21–23]. The various estimates are summarized in Table 6, where footnotes provide indications of how they were derived and their relative quality and reliability.

The estimates in the baseline document represent the first attempt to provide a comprehensive compilation of the costs for the remediation of most legacy sites in Central Asia — estimates were made separately of the costs of evaluating the risks at each site and identifying preferred remediation options, as well as the costs of remediation per se. These estimates are inevitably approximate and associated with much uncertainty, being based only on information readily available at the time and without the benefit of any dedicated site-specific investigations having been conducted. Estimates made at national levels are more soundly based, but are not always drawn from systematic and comprehensive evaluations of risks and remediation options. They also suffer from uncertainties over currency conversion and inflation. The estimates made in the IAEA missions to Kyrgyzstan and Tajikistan in 2016 and 2017 are intended only to be indicative; they are based on limited site investigations and access to information (but not costs), where available, on site characteristics etc., gathered during more systematic and comprehensive evaluations of risks and remediation options (i.e. those being carried out for Min-Kush and Shekaftar with support from the CIS Programme [14] and the EU’s INSC [19]).

The estimates made in the systematic and comprehensive evaluations undertaken with support from the CIS Programme and the EU’s INSC are, in general, the most rigorous and

37 Discounting Kyzyl-Djar and Tuya-Moyun, which are not priorities for remediation, and Gafurov, which appears to have been satisfactorily remediated.
reliable, and they are being, or will be, used as a basis for tendering for remediation work at various sites. Some of the estimates are, however, preliminary (and indicated as so in Table 6) and are associated with greater uncertainty; they may change when the evaluations are complete, final values become available and the market has had an opportunity to respond.

There is much variability in the costs summarized in Table 6. This is a result of the varying quality and/or rigour of the different estimates and differences in assumptions about the nature and scale of the preferred remediation options (e.g. removal of tailings to another location as opposed to in situ remediation). Notwithstanding reservations on the quality and uncertainty of, some of the costs, they can be used to make plausible estimates of the costs of remediation of uranium legacy sites in each of the three Member States and overall. These are: about €100 million for Kyrgyzstan; about €70 million for Tajikistan; about €7 million for Uzbekistan; and about €180 million overall.

The following protocol was used in choosing ‘best estimates’. Costs (preliminary or final) derived from systematic and comprehensive evaluations of risks and remediation options were adopted when available (i.e. as estimated in studies carried out with support from the CIS Programme or the EU's INSC).

In their absence, costs estimated nationally were adopted — with the exception of Mailuu-Suu, where the average of the national and the IAEA estimates was chosen, and of Buston (Karta 1–9), where the IAEA indicative estimate was chosen because the national estimate only covers the cost of emergency measures and not the full cost of remediation. For Min-Kush (tailings) and Yellow Hill, and the tailings piles 1–4 at Istiklol, two estimates were available: from the CIS Programme and the EU's INSC. For Min-Kush the CIS estimate was adopted, as this is the remediation option being implemented; for Yellow Hill and the tailings piles 1–4 at Istiklol, the average of the two estimates was adopted, as both are preliminary. Because there are indications that national estimates of costs may be underestimates, ‘best estimate’ values in Table 6, based on national estimates, should be considered as indicative of the lower bounds of those that may occur in practice.
Table 6. Estimates of the costs of environmental remediation of uranium legacy sites

<table>
<thead>
<tr>
<th>ULS</th>
<th>Estimated remediation costs (millions of euros)</th>
<th>Document</th>
<th>National (Kyrgyzstan or Tajikistan only)</th>
<th>IAEA (indicative)</th>
<th>Comprehensive/systematic evaluation</th>
<th>‘Best estimate’</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td></td>
<td></td>
<td></td>
<td>CIS</td>
<td>EU INSC</td>
</tr>
<tr>
<td>Kyrgyzstan</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mailuu-Suu</td>
<td>1.7</td>
<td>16</td>
<td>42</td>
<td>20</td>
<td></td>
<td>29</td>
</tr>
<tr>
<td>Min-Kush (tailings)</td>
<td>4.7</td>
<td>4.3</td>
<td>43</td>
<td>20</td>
<td></td>
<td>23</td>
</tr>
<tr>
<td>Min-Kush (other objects)</td>
<td></td>
<td>2.0</td>
<td>20</td>
<td>20</td>
<td></td>
<td>4.1</td>
</tr>
<tr>
<td>Kara Balta</td>
<td>23</td>
<td>30</td>
<td>20</td>
<td>20</td>
<td></td>
<td>30</td>
</tr>
<tr>
<td>Kadij-Say</td>
<td>0.8</td>
<td>3.2</td>
<td>7.0</td>
<td>1.5</td>
<td></td>
<td>1.5</td>
</tr>
<tr>
<td>Shekaftar</td>
<td>0.5</td>
<td>1.4</td>
<td>7.9</td>
<td>3.5</td>
<td></td>
<td>3.5</td>
</tr>
<tr>
<td><strong>Kyrgyzstan sub-total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>≈100</td>
</tr>
<tr>
<td>Tajikistan</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Istiklol (Yellow Hill and tailings 1–4)</td>
<td>13</td>
<td>7.1</td>
<td>12</td>
<td>20</td>
<td></td>
<td>16</td>
</tr>
<tr>
<td>Istiklol (WTF)</td>
<td></td>
<td></td>
<td></td>
<td>2.5</td>
<td></td>
<td>2.5</td>
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<tr>
<td>Istiklol (other objects)</td>
<td></td>
<td></td>
<td></td>
<td>13</td>
<td></td>
<td>13</td>
</tr>
<tr>
<td>Degmay</td>
<td>15</td>
<td>8.3</td>
<td>25</td>
<td>25</td>
<td></td>
<td>25</td>
</tr>
<tr>
<td>Adrasman</td>
<td>0.4</td>
<td>2.4</td>
<td>25</td>
<td>25</td>
<td></td>
<td>2.4</td>
</tr>
<tr>
<td>Buston (Karta 1–9)</td>
<td>0.25</td>
<td>0.1</td>
<td>10</td>
<td>10</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>Khujiang</td>
<td>0.4</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
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<td>0.5</td>
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<tr>
<td><strong>Tajikistan sub-total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>≈70</td>
</tr>
<tr>
<td>Uzbekistan</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charkesar</td>
<td></td>
<td></td>
<td></td>
<td>0.6</td>
<td></td>
<td>0.6</td>
</tr>
<tr>
<td>Yangiabad</td>
<td></td>
<td></td>
<td></td>
<td>6.3</td>
<td></td>
<td>6.3</td>
</tr>
<tr>
<td><strong>Uzbekistan sub-total</strong></td>
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<td></td>
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<td></td>
<td>≈7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>≈180</td>
</tr>
</tbody>
</table>

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a. Costs are quoted to no more than two significant figures to avoid undue perceptions of accuracy. Because of rounding, the total costs may not equal the sum of the tabulated component costs.
b. Costs given in [8–10, 16].
c. Costs are solely indicative; they were made during IAEA missions to Kyrgyzstan and Tajikistan in October 2016 and March 2017, based on limited site investigations, an awareness of the site characteristics, etc., and information about costs at other sites where more systematic and comprehensive evaluations had been, or were being, made [43].
d. Costs obtained from systematic and comprehensive evaluations of risks and remediation options in projects supported by CIS Programme or EU’s INSC [18–23]; in some cases the estimates are preliminary, and these are qualified accordingly.
e. All INSC costs include a conservative 20% provision to cover the costs of Project Management Unit supervision and monitoring.
f. The ‘best estimate’ costs are: those estimated in one or other CIS or EU INSC comprehensive study, where available (even if preliminary), apart from where preliminary estimates have been made by both CIS and INSC. In the case of Yellow Hill and tailings 1–4 at Istiklol, the average of the two estimates has been adopted, and in the case of Min-Kush, the CIS estimate has been used (see h below); otherwise, national estimates have been used, except when an indicative estimate has also been made by the IAEA. In the case of Mailuu-Suus, the ‘best estimate’ is the average of the national and IAEA estimates, and in the case of Boston (Karta 1–9) the ‘best estimate’ is the IAEA estimate, as the national estimate only covers partial remediation (see note below).
g. The costs of remediation of the two relatively small legacy sites at Kyzyl-Djar and Tuya-Moyun have not been included because these sites are not priorities for remediation and their remediation costs are likely to be small in comparison.
h. Remediation of Min-Kush tailings will be implemented in accordance with the option proposed in the CIS project, and its costs are considered as the ‘best estimate’; the lower cost estimate in the EU-INSC evaluation is a consequence of the preferred remediation option requiring the relocation of a smaller volume of tailings (see Section 3.3.1.2).
i. Preliminary estimate; final estimate may be somewhat greater.
j. Preliminary estimate with an indicative uncertainty of about ±30%.
k. Average of the CIS and EU INSC preliminary estimates.
l. Cost of providing a 0.5 m cover for Karta 1–9 as an emergency measure; costs of full remediation would be considerably greater.
3.5.1.3 Capacity-building and support for regional cooperation

Indicative costs of further support for capacity-building and regional cooperation (i.e. in addition to support that is ongoing and already funded — see Section 3.4) are summarized in Table 5 for those (complementary) activities judged to be essential for achieving timely, effective and sustainable remediation of the identified legacy sites/objects.

The overall further costs are estimated to be about €10 million, and can be further refined when ongoing studies are completed (i.e. development of a regional watershed monitoring system) and/or more detailed analyses are made of the resources that will be required to meet the various needs set out in Section 3.4.

3.5.1.4 Overall costs for environmental remediation and supporting activities

The costs of remediation, together with other essential supporting activities, are summarized in Table 7 for each of the uranium legacy sites included in the Strategic Master Plan. Costs are provided separately for activities that have been completed and/or for which funding has been spent or committed, and for those for which additional funding will be needed (i.e. additional cost). Costs are broken down into those for carrying out site evaluations, for remediation and for supporting activities and capacity building.

Table 7. Summary of the overall costs of remediating uranium legacy sites (remediation plus supporting activities)

<table>
<thead>
<tr>
<th>Site</th>
<th>Spent/committed (millions of euros)</th>
<th>Estimated additional cost (millions of euros)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Evaluations</td>
<td>Remediation</td>
</tr>
<tr>
<td>Kyrgyzstan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kadji-Say (tailings)</td>
<td>0.2</td>
<td>1.5</td>
</tr>
<tr>
<td>Kara Baht</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mailuu-Suu</td>
<td>3.2</td>
<td>11</td>
</tr>
<tr>
<td>Min-Kush (tailings)</td>
<td>4.3&lt;sup&gt;b, c&lt;/sup&gt;</td>
<td>23</td>
</tr>
<tr>
<td>Min-Kush (other)</td>
<td>0.3&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Shekaftar</td>
<td>0.3&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td><strong>Sub-totals</strong>&lt;sup&gt;a&lt;/sup&gt;</td>
<td><strong>8.1</strong></td>
<td><strong>36</strong></td>
</tr>
<tr>
<td>Tajikistan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adrasman</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buston - Degmay</td>
<td>1.1&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.3</td>
</tr>
<tr>
<td>Buston - Karta 1-9</td>
<td>0.04</td>
<td></td>
</tr>
<tr>
<td>Buston - Khujand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Istiklol (Yellow Hill and tailings)</td>
<td>0.7&lt;sup&gt;b, e&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Istiklol (other)</td>
<td>0.6&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Istiklol (WTF)</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td><strong>Sub-totals</strong>&lt;sup&gt;a&lt;/sup&gt;</td>
<td><strong>2.4</strong></td>
<td><strong>2.8</strong></td>
</tr>
<tr>
<td>Uzbekistan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charkesar</td>
<td>0.1&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Yangiabad</td>
<td>1.4&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td><strong>Sub-totals</strong>&lt;sup&gt;b&lt;/sup&gt;</td>
<td><strong>1.5</strong></td>
<td>0</td>
</tr>
<tr>
<td><strong>Sub-totals (all)</strong>&lt;sup&gt;b&lt;/sup&gt;</td>
<td><strong>12</strong></td>
<td><strong>39</strong></td>
</tr>
<tr>
<td><strong>Total</strong>&lt;sup&gt;b&lt;/sup&gt;</td>
<td><strong>56</strong></td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> Except for Kyzyl-Djar and Tuya-Moyun, which are not priorities for remediation and the costs of which are likely to be small in comparison, and Gafurov, which appears to have been satisfactorily remediated.
a. Costs are quoted to no more than two significant figures to avoid undue perceptions of accuracy. Because of rounding, the totals and subtotals may not equal the sum of the tabulated component costs.

b. Costs for systematic and comprehensive evaluations of risks and remediation options under the EU-INSC programme are based on totals for groups of sites/objects (Min-Kush and Shekaftar; Istiklol and Degmay; Charkesar and Yangiabad) apportioned according to the estimated costs of remediation; they should be regarded as indicative.

c. Costs of evaluations at Min-Kush (tailings) includes the costs of evaluations at both Min-Kush and Istiklol under the CIS Programme on tailings, as well as the (apportioned) costs of evaluations at Min-Kush under the EU’s INSC programme.

d. Costs solely indicative based on costs of evaluations of other sites; actual costs likely to be lower.

e. Costs of evaluations at Istiklol (Yellow Hill and tailings) are the (apportioned) costs under the EU’s INSC programme; those under the CIS Programme are included with those for Min-Kush (tailings).

Similar information is presented graphically in Figure 3, where an estimate is given of funding still needed (i.e. in addition to funds currently held, but not yet allocated, by the EBRD’s ERA and the CIS Programme) to carry out the identified remediation activities.

![Figure 3](image_url)

**Figure 3. Summary of costs of Strategic Master Plan activities and of funding committed, unallocated and needed**

The overall costs of remediating the uranium legacy sites listed in Table 1,40 together with supporting activities, are estimated to be about €210 million. By far the majority of these costs (about €180 million) are for remediation work per se, with around €17 million for comprehensive evaluations of the risks and remediation options and some €15 million to support capacity-building and other activities.

In total, about €56 million has already been spent or committed for evaluations, remediation and supporting activities. This includes the following:

- Around €12 million for systematic and comprehensive evaluations of the risks and remediation options;
- Around €11 million spent at Mailuu-Suu with World Bank funding;
- €25 million committed by the CIS Programme for the remediation of tailings at Min-Kush and Kadji-Say;
- €2.5 million allocated by the EU’s INSC for the treatment of mine waters at Istiklol;
- Around €5 million for capacity-building.

40 Discounting Kyzyl-Djar and Tuya-Moyun, which are not priorities for remediation and the costs of which are likely to be small in comparison; and Gafurov, which appears to have been satisfactorily remediated.
Funds currently held within ERA amount to about €16.45 million, and some €12 million are available within the CIS Programme, provisionally foreseen for the remediation of Yellow Hill and tailings 1–4 at Istiklol. This leaves a shortfall of around €130 million that will need to be acquired from other sources to achieve the remediation foreseen in the Plan.

3.6 Institutional and organizational arrangements and funding

The core group of CGULS has developed this Strategic Master Plan on behalf of the Central Asian Member States. The group comprises representatives of the EBRD, the EC, the IAEA, Kyrgyzstan, the Russian Federation, Tajikistan and Uzbekistan. Other members of CGULS and/or participants in its meetings (e.g. BGR, the Institut de Radioprotection et de Sûreté Nucléaire (IRSN) in France, the Studiecentrum voor Kernenergie–Centre d’Étude de l’Énergie Nucléaire (SCK-CEN) in Belgium, the NRPA, FSD, Wismut GmbH, UNDP, UNEP, OSCE, Ukraine) have reviewed the draft Strategic Master Plan and provided feedback on its scope and content.

A commitment to follow and/or adopt the broad principles and approach set out in this Strategic Master Plan will be an important consideration in obtaining donor support for remediation of uranium legacy sites in Central Asia. As part of the consultation process to develop the Plan, the three Member States were provided with the final draft of the Plan in May 2017 for approval through their respective governmental processes. The Plan was also presented to the General Assembly of the Environmental Remediation Account (ERA) in July 2017, with a request to endorse it as the basis for ERA operations in Central Asia. Each of the three Member States, as well as the EBRD and EC, approved the final draft, which was officially endorsed at a signing ceremony in Vienna on 18 September 2017 during the 61st IAEA General Conference. The Plan was submitted for consideration to the Economic Council of the Commonwealth of Independent States (CIS), with formal endorsement received on 22 March 2018.

The Plan responds directly to the needs and priorities identified by Kyrgyzstan and Tajikistan (and at least partially by Uzbekistan) for environmental remediation of their uranium legacy sites, albeit constrained in scope, content and timing by plausible assumptions on the availability of funding from third parties.

The core group of CGULS will monitor the implementation of the Plan and oversee its periodic updating. In practice, these roles will be fulfilled by the IAEA, in its capacity as the secretariat of CGULS, with the support of, and in consultation with, the core group. In this role, the secretariat will:

- Promote the adoption of a systematic, integrated and coherent approach to environmental remediation in Central Asia;
- Establish a procedure for the core group to monitor the implementation of the Strategic Master Plan and update it as necessary;
- Support the development and promote the use of a common, systematic approach for evaluating the health and environmental risks of uranium legacy sites and options for their remediation;
- Advise potential donors to make the provision of third-party support and funding for remediation conditional upon the existence of the following:
  - A systematic and comprehensive evaluation of the risks presented by a legacy site (or an object within it) and options for its remediation, including costs;
  - Identification of the preferred option or options;

41 The Economic Council comprises the deputy Head of Government of each State in the CIS.
A technical specification of the remediation works to be undertaken and their costs;

Approval by the relevant national authorities regarding, inter alia, the safety and sustainability of the proposed remediation. An EIA and consultation with interested parties would be essential parts of this process;

- Facilitate the establishment of a mechanism for coordination between the EBRD’s ERA and the CIS Programme in the funding and implementation of environmental remediation of uranium legacy sites in Central Asia;
- Facilitate the sharing of information between all parties with a view to better informing decisions of the main funding bodies (ERA and the CIS Programme) on the relative priority to be accorded to the remediation of the various sites and/or objects;
- Encourage donors to ensure that the scale, nature and timing of remediation activities — both the identification of preferred options and subsequent remediation activities — are compatible with the capacities of the site owners and, in particular, the regulatory authorities;
- Encourage donors to support, where necessary, national regulatory authorities in carrying out reviews and approving the safety and environmental acceptability of any proposed remediation (during both the planning and implementation stages);
- Facilitate cooperation with regional and/or international development organizations (e.g. UNDP) so that remediation projects also aim for longer term and sustainable socioeconomic improvements in the affected areas.

Appropriate administrative and other arrangements have been or will be made for these purposes by the secretariat on behalf of the core group; the timing of the more significant activities is explicitly identified in the plan in Figures 2.1 and 2.2.

The main spheres of interest of the core group members are illustrated in Figure 4. The IAEA has focused (and will continue to focus) on capacity-building in addition to supporting the core group and CGULS more generally in a coordination/secretariat role.

The European Commission, through the EU’s INSC, has focused on capacity building, evaluations of the risks and remediation options for many of the legacy sites in Central Asia, and the establishment and initial funding of ERA (now managed by the EBRD), and has made a contribution to remediation of one object at a uranium legacy site. To date it has contributed about €31 million in supporting these activities, of which €16.45 has been directly contributed to ERA. With the establishment of ERA and the completion of evaluations of risk and remediation options for most ULS, the European Commission’s focus is expected to shift in future more towards capacity-building.

[Diagram: Figure 4. Main roles of core group members in funding environmental remediation of ULS]
The EBRD, through its multidonor ERA, will focus on actual remediation of uranium legacy sites, but will support other activities to the extent that they are necessary to ensure that remediation is carried out effectively and efficiently. Some €16.45 million is currently held in ERA, and a donor conference will take place in 2018.

The CIS has to date focused on evaluating the risks and remediation options at three high risk objects at ULS in Kyrgyzstan and Tajikistan, developing plans for their remediation, and capacity-building. Support will continue for capacity-building but the focus will now shift to undertaking remediation of these objects; consideration will be given to the extension of its programme to other high risk sites/objects. Around €25 million has been allocated or committed to these activities in relation to the remediation of two of the objects (i.e. tailings at Min-Kush and Kadji-Say), and a decision is pending on the resources to be committed to Yellow Hill and tailings 1–4 at Istiklol.

The Strategic Master Plan foresees third-party financial support for environmental remediation of uranium legacy sites in Central Asia being channelled and coordinated through the EBRD’s ERA. Funding and support from CIS Member States is currently being channelled and coordinated through the CIS Programme. These arrangements will be without prejudice to funding and support being provided through other mechanisms (e.g. bilateral arrangements) where the use of one or other of the above approaches is not possible.

Mechanisms are being developed for coordination between the EBRD’s ERA and the CIS Programme in the funding and implementation of environmental remediation of uranium legacy sites in Central Asia, while fully respecting their administrative, financial and operational procedures. These mechanisms will enable an integrated, systematic and fully coordinated approach to remediation that will make best use of limited funding and of human resources.

The EBRD established the ERA for Central Asia in 2015, and it became operational following an initial contribution from the European Commission. The first meeting of its Assembly of Contributors was held in July 2016. The Strategic Master Plan and the systematic and comprehensive evaluations of risks and remediation options for various uranium legacy sites provide the strategic underpinning for ERA, and will enable informed decisions on the allocation of ERA resources by its Assembly.

Framework Agreements, which have the status of international treaties and provide the legal basis for ERA operations, are in place between the EBRD and Kyrgyzstan, Tajikistan and Uzbekistan. Project Management Units (PMUs) are being established for the purposes of tendering and oversight of remediation projects funded by ERA. All the necessary operational building blocks for contracting projects will be established from 2018.

A high level donors’ or pledging conference is scheduled for 2018, at which a portfolio of ‘implementation ready’ remediation projects will be presented and contributions sought to ERA. The size of these contributions will determine the rate at which required remediation, as identified in this Strategic Master Plan, can be undertaken, particularly as the costs are likely to exceed the initial contribution to ERA from the European Commission. Decision making for remediation projects funded by ERA rests with the ERA General Assembly.

The CIS Programme for remediation of uranium legacy sites in Kyrgyzstan and Tajikistan is based on a concept developed during the period 2008–2012 for the remediation of the territories of EurAsian Economic Community (EurAsEC) Member States affected by uranium mining industries. It was approved by a decision of the EurAsEC Interstate Council in 2012. Funding is being provided by those CIS Member States participating in the programme, namely the Russian Federation (75%), Kazakhstan (15%), Kyrgyzstan (5%) and Tajikistan (5%); their contributions take account of a number of socioeconomic indicators, including GDP.
The first phase of the programme (2013–2016) focused on the evaluation of risks and options for remediation at high risk objects at Min-Kush, Kadji-Say and Istiklol; based on these evaluations, plans were developed to carry out the identified remediation. These plans are based on Russian standards adapted to conditions in Kyrgyzstan and Tajikistan (i.e. regulations, norms, standards, etc.).

The second phase (2017–2023), for remediation of high risk objects in Kyrgyzstan and Tajikistan, was approved in October 2016 by a decision of the Council of the Deputy Heads of the Governments of the CIS member states: 2.53 billion (€39 million) was allocated for the remediation of tailings at Min-Kush and Kadji-Say, together with a provision for remediation of Yellow Hill and tailings 1–4 at Istiklol. The cost of the proposed remediation at Istiklol, based on a preliminary estimate, is around 800 million (€12 million), but the final cost may be somewhat greater depending on the detailed design and specification of the project and requirements imposed by the Tajik regulatory authorities.

Decision making within the CIS Programme rests with the Council of the Deputy Heads of the Governments of the CIS member states; a Council decision to proceed with the remediation of Istiklol is foreseen in the fourth quarter of 2018.

Projects funded or supported by the CIS and ERA will largely focus on the physical remediation of uranium legacy sites in order to mitigate or remove existing and future risks and improve amenity. The reduction and/or removal of risks and restored environments will be leveraged by initiatives to improve socioeconomic conditions and amenities in the affected areas, particularly as many have suffered for decades from blight, depopulation and lasting concerns over legacy risks following the closure of uranium mining. Arrangements will be put in place to liaise with UNDP and others that may contribute to enhancing socioeconomic conditions in parallel with or following any remediation works.
4. References
4. References


[6] Measures to strengthen international cooperation in nuclear, radiation, transport and waste safety, IAEA General Conference Resolutions GC(53)/RES/10, para 65; GC(54)/RES/7, para 54; GC(55)/RES/9, para 66; GC(56)/RES/9, para 64; GC(57)/RES/9, para 86; GC(58)/RES/10, para 90, IAEA, Vienna (2009–2014).


[15] EUROPEAN UNION INSTRUMENT FOR NUCLEAR SAFETY COOPERATION, Terms of Reference for INSC projects UZ4.01/10, KG4.01/11-12, TJ4.01-02/11, KG4.01/14 and MC4.02/13A.


[18] EUROPEAN UNION INSTRUMENT FOR NUCLEAR SAFETY COOPERATION, Conducting an Integrated Environmental Impact Assessment and Feasibility Study for the Safe Management and Remediation of the Uranium Legacy Complex of Mailuu-Suu, ToR and project documentation for INSC project KG4.01/14.

[19] EUROPEAN UNION INSTRUMENT FOR NUCLEAR SAFETY COOPERATION, Conducting an Integrated Environmental Impact Assessment and Feasibility Study for the Management and Remediation of Uranium Production Legacy Sites of Min-Kush and Shekaftar in the Kyrgyz Republic, ToR and project documentation for INSC project KG4.01/11-12.


[21] EUROPEAN UNION INSTRUMENT FOR NUCLEAR SAFETY COOPERATION, Conducting an Integrated Environmental Impact Assessment and Feasibility Study for the Management and Remediation of the Uranium Production Legacy Sites of Degmay and Istiklol (formerly Taboshar) in Tajikistan, ToR and project documentation for INSC project TJ4.01-02/11.

[22] EUROPEAN UNION INSTRUMENT FOR NUCLEAR SAFETY COOPERATION, Detailed Design and Engineering of a Water Treatment Facility for Istiklol (formerly Taboshar), ToR and project documentation for INSc project MC4.02/13A.


[27] EUROPEAN UNION INSTRUMENT FOR NUCLEAR SAFETY COOPERATION, Establishment of a Legislative and Regulatory Framework, Regional Watershed Monitoring System and Capacity Building for Remediation of Uranium Mining Legacy Sites in Central Asia, ToR and project documentation for INSC project REG4.01/10.

[28] EUROPEAN UNION INSTRUMENT FOR NUCLEAR SAFETY COOPERATION, Stakeholder Engagement in Remediation of Uranium Legacy Sites in Central Asia, ToR and project documentation for INSC project MC4.02/13, implemented by ENVSEC (UNDP, OSCE and UNEP).

[29] COMMONWEALTH OF INDEPENDENT STATES, Agreement on 'More Harmonized Approaches to Legal and Technical Regulations, Conformity Assessment, Standardization, Accreditation and Metrology in the Field of Nuclear Energy for Peaceful Purposes'. Expected to come into force in 2017.


[38] INTERNATIONAL ATOMIC ENERGY AGENCY, Convention on Early Notification of a Nuclear Accident, IAEA, Vienna (1986).


Appendices
Appendix A.
Uranium Legacy Sites in Central Asia

Overview

Uranium mining and processing activities were carried out in Central Asia for more than 40 years from the mid-1940s. Many of these activities were centred on the mountainous areas above the valley of the Syr-Darya river, where Kyrgyzstan, Uzbekistan, Tajikistan and Kazakhstan intersect (see Figure A1). The activities have left a legacy of closed uranium mining and milling sites, together with associated waste rock dumps and low grade ore and tailings piles. These sites are often close to national borders and potentially pose transboundary as well as local risks. The main characteristics of the legacy sites in each country are summarized below.

Figure A1. Locations of key uranium legacy sites of concern in Central Asia1. Adapted from maps provided by the UN Geospatial Information Section.

Kyrgyzstan

The main uranium ore mining and processing facilities in Kyrgyzstan include: enterprises of the former Leninabad Mining and Chemical Plant (SE “Vostokredmet”) in Mailuu-Suu, Shekaftar, Kyzyl-Djar; and enterprises of the Kara-Balta mining plant (KBMP) in Kara Balta, Min-Kush and Kadjji-Say. The long-term activity of these uranium mines and processing enterprises has resulted in the accumulation of over 132 million m3 of waste. Many of the sites are located near the borders of Kyrgyzstan and/or near tributaries of the transboundary systems of the Syr-Darya and Chu rivers (see Figure A2). Many are also located in seismically active mountainous areas.

1 Istiqlol and Buston in Tajikistan were formerly known as Taboshar and Chkalovsk, respectively.
Figure A2. Locations of uranium legacy sites in Kyrgyzstan. Adapted from maps provided by the UN Geospatial Information Section.

The key uranium legacy sites of Mailuu-Suu, Min-Kush, Kara Balta, Kadji-Say and Shekaftar are described in more detail below.

Mailuu-Suu

Mailuu-Suu is a mining town in Jalal-Abad Region of southern Kyrgyzstan that has been economically depressed since the fall of the Soviet Union. From 1946 to 1968 the Zapadnyi Mining and Chemical Combine in Mailuu-Suu mined and processed more than 9,000 tonnes of uranium ore for the Soviet nuclear programme.

A total of 2,095 million m³ of tailings were generated and subsequently disposed of at 23 sites having a total area of 49.76 ha. At 11 of the sites, confined tailings storage facilities (TSFs) were constructed and, at the remaining 12 sites, unconfined dry tailings heaps (DTH) were created. There are also 13 waste rock dumps. Uranium mining and processing is no longer economical, leaving much of the local population of about 20,000 without meaningful work.

The town of Mailuu-Suu is located in close proximity to the tailings facilities and waste rock dumps. The shortest distance from these uranium legacies to the city limits of Mailuu-Suu is 300 m. Smaller settlements are located in the valleys of the Mailuu-Suu, Kara Agach and Aylampa-Say rivers. In most cases the tailings and waste rock dumps are upstream of these communities, sometimes not more than 500 m from their houses. In Kara Agach some waste rock dumps are even located in the centre of the settlement.

The upper reaches of the Sary-Bee river (a tributary of the Mailuu-Suu river), 12 km upstream from Mailuu-Suu, are used for water supply. Waters fed by glaciers and some springs are collected 3 km upstream from the Sary Bee settlement and conducted downstream by three water pipes to serve the local population. These water pipes are buried for some stretches along the right-hand side of the Mailuu-Suu river valley and may have suffered some damage from slope movements and landslide activity.

All the Mailuu-Suu tailings facilities are located in a region prone to earthquake activity — earthquakes can trigger landslides or damage tailings dams directly. In addition, along the Mailuu-Suu river, the tailings facilities are within the erosional reaches of the river. The continuous erosion of the riverbanks and the erosion of the tailings dams by floods are very powerful long-term processes with the potential to cause future tailings dam failures and the release of tailings. A particularly sensitive time for tailings release is the annual spring flood of the Mailuu-Suu river after snowmelt. Figure A3 indicates the location of the legacy facilities in relation to the rivers and the landslide- and mudflow-prone areas around Mailuu-Suu.
After the mining and milling operations were terminated, the tailings were ‘conserved’ (i.e. they received a surface cover) in order to protect the public from radiation exposure and the tailings from surface run-off and erosion. Many of the TSFs remained in various stages of ‘conservation’ or had no protective measures at all. In the case of the dry tailings heaps, the only protection against erosional degradation was the natural vegetation.

In support of tailings de-watering at the facilities, drainage pipelines were placed into the gravel/pebble layer of the cover. These drainage pipes have corroded and/or become blocked by residues and are seldom functional. The cover profiles of the TSFs are in various states of degradation; the cover thickness is sometimes as little as 50 cm and often eroded. In some cases (in the Aylampa Say valley), additional cover has developed on the tailings surface as natural soils were washed onto the TSFs from the adjacent natural slopes.

Compared with the surrounding landscape, the surface of the tailings facilities often has a well-developed rich grass cover (probably due to the good water retention capacity of the tailings) and is favoured by domestic animals (goats and cattle) as pasture land.

Concrete drainage channels were built to divert water from the surface of the TSFs, bypassing the tailings dams and discharging into the nearby low-lying drainage areas or directly into the river. This results in the small scale but chronic release of tailings and dissolved uranium. No provisions were made for seepage water treatment at any of the legacy facilities at Mailuu-Suu.

The construction of TSFs did not include the construction of liners and, because the underlying geology is in most cases karstic limestone, it is very likely that the groundwater under a number of TSFs has been receiving contaminated tailings seepage since the construction of the facilities.
The geodynamic processes acting in the area have the potential to disrupt the tailings dams and bring about a sudden physical release of tailings. In addition, the Mailuu-Suu river has the capability of acting as a transport agent for the tailings materials and the dissolved contaminants leaching from the TSFs.

In 2004, the World Bank approved a grant to reclaim the tailings pits. During the preparation stage of the project, it became clear that comprehensive remediation would exceed the available financial resources of US$8 million. A budget increase to US$12 million was approved, but remediation measures still had to be limited to high-risk objects.

Within the project, DTH# 3 was relocated from an unstable site on the left bank of the Mailuu-Suu river to a more secure location in TSF#6. In addition, the waste rock pile WD#1 (9 900 m³) was relocated to WD#2 (13 800 m³) and the two rock piles (both on the south side of the Kulmen Say valley) were remediated jointly.

A bypass channel was constructed for the Kulmen Say to prevent contaminated seepage (up to several hundred micrograms of uranium per litre) from both piles entering the Kulmen Say and then being transported into the Mailuu-Suu river. However, when the project was completed in 2012, most of the tailings facilities remained unremediated.

Min Kush

Min-Kush is located approximately 130 km south of Bishkek in the Moldo-Too/Kavak-Too mountain range, which is part of the Tien-Shan mountains. The Min-Kush mining and milling site is located in mountainous terrain close to the town of Min-Kush, some 2 100 m above sea level. The mine and mill site comprises four closed mines, four waste rock piles and tailings facilities (see Figure A4). The tailings are stored at four impoundment facilities: Tuyuk-Suu, Taldy-Bulak, Kak and Dalnee. These facilities were active between 1955 and 1960 when the mill was operational. They contain an estimated total of 1.9 million m³ of uranium tailings and cover an area of 19.65 ha. The facilities are located within 11 km of the town of Min-Kush, on the banks of the Min-Kush river. The Tuyuk-Suu impoundment is approximately 2 km from Min-Kush on the Tuyuk-Suu river. The Taldy-Bulak, Kak and Dalnee impoundments are between 9 and 11 km from Min-Kush. The Taldy-Bulak facility is located on a tributary of the Min-Kush river in a mountain valley above the Min-Kush river, while Kak and Dalnee are at higher elevations at some distance from the Min-Kush river.

Figure A4. Min-Kush mining and milling site. [19]
The town of Min-Kush was built between 1944 and 1950 in connection with uranium mining. The town was heavily affected when the uranium mining operation ceased in the late 1960s and with the collapse of the Soviet Union in the 1990s. Having had up to 19,000 inhabitants in the 1960s and still 8,000 in the early 1990s, the current population is only around 3,200.

As a result of the population decline, many houses are in a poor state or in ruins and the community infrastructure cannot be properly maintained. Agriculture is not viable because of the high altitude and land is mainly used for livestock grazing. There is very limited production of vegetables in small garden plots. The economy is characterized by low-income consumers, with low purchasing power and lack of prospects. The unemployment rate is at approximately 40%.

Some buildings in the town of Min-Kush are located on the former mining and processing site. As there is no fence or other access control, people living in the area are known to have collected contaminated residues (metals, building materials and other waste) for domestic purposes. The total estimated contaminated area is about 61,000 m². The average gamma dose rate is between 0.30 μSv/h and 1.0 μSv/h, with some locations recording 1.0 μSv/h to 5.0 μSv/h. High 222Rn levels have been measured in some of the houses in the community.

The functionality of the diversion channels at the Tuyuk-Suu tailings pond is endangered. The total volume of the deposited uranium tailings in this pond is estimated as 490,000 m³, covering an area of about 4.4 ha. There is evidence of landslide activity close to the tailings pond. No monitoring or maintenance is in place at the other three tailings impoundments. Although the Tuyuk-Suu and Taldy-Buluk impoundments present only a moderate risk for the Tuyuk-Suu river, the river is a tributary of the Syr-Darya river and any contamination could have cross-border implications.

Karla Balta

The tailings dump has been in use since 1955 and is located near the town of Kara Balta (1.5 km away), which has a population of more than 50,000. The total amount of radioactive waste in the tailings dump is about 37 million m³ and its design capacity is about twice as much, some 63.5 million m³.

This site has been in private hands since 2008. The current owner is a Kyrgyz company, Open Joint Stock Company (OJSC) - Karabaltinskiy Mining Plant (KBMC). The processing of uranium ores has continued since then (mainly sourced from Kazakhstan) and the intent had been to reprocess the whole of the tailings to extract further uranium and other metals (e.g. molybdenum) and, while doing so, remediate the tailings dump in accordance with state of the art international practice.

More recently, the processing of uranium ores has ceased and the site is no longer operational — presumably because the planned extraction of further uranium and other metals from the tailings is no longer economical and/or practicable. Activities are now limited to ensuring the safety and security of the site, with minimal levels of staffing. While the site remains in private ownership, ownership of the tailings would appear to remain with the Government, which leased/rented the tailings to OJSC-KBMC for a period of 49 years (from 2009) under a governmental decree.

Groundwater analysis and control is carried out under the National Project on Monitoring Groundwater in the Northern Region of the Kyrgyz Republic. Chemical and radiological analyses are made at 160 sampling points. Gamma dose rate surveillance measurements are made on the tailings dump and its sanitary protective zone once every three years, together with measurements of radionuclides in soil and vegetation. Gamma dose rates are measured quarterly in the town of Kara Balta and have varied within the range 0.16–0.22 μSv/h (16–22 μR/h), i.e. consistent with natural background radiation.

No comprehensive evaluation appears to have been made of the health and environmental risks from the tailings dump and the measures that need to be taken to remedy the situation.
Kadji-Say

The Kadji-Say tailings impoundment is located in the Ton region in Issyk-Kul oblast on the southern shore of Lake Issyk-Kul. It contains mainly a mixture of mill waste, coal ash from the former thermal power plant, waste rock and the residue of coal ash processed for uranium extraction. Metal scrap was also disposed of in the waste dumps and elsewhere. In 2006, some remediation works were carried out, financed through ISTC (International Science and Technology Centre, Moscow) and coordinated through the U.S. Department of Energy (DoE) and the Lawrence Livermore National Laboratory (LLNL) in the United States.

The rehabilitation plan focused on the consolidation of waste at a minimum number of locations, and the installation of a protective cover on the tailings impoundment surface to minimize radon emanation and gamma radiation dose, and to protect it against erosion and contamination. The cover was not completed, however, leaving the face of the pile at the bottom exposed, and the mixture of ash-clay used for the cover was later found to be an unsuitable material for the purpose. In addition, the fence system around the tailings impoundment was not restored. The local population therefore has free access to the tailings impoundment and continues to excavate and sell metal scrap.

Shekaftar

The Shekaftar site is located in the Ala-Bukynsky District of Jalal-Abad Province. The site was operational between 1946 and 1957. The mining complex comprises three closed mines and eight mining waste disposal areas that contain about 700 000 m³ of waste rock and low grade ores. Five of the sites (No. 1, 2, 5, 6 and 7) are located inside the village of Shekaftar, two (mine sites 3 and 4) are west of the village, and one (mine site 8) is east of the village (see Figure A5).

The village of Shekaftar and the neighbouring village of Sumsar have a combined population of 6 500. Houses with gardens are located in the vicinity of the mine sites and none of the waste rock dumps have been rehabilitated. The average dose rate on the surface of the disposal areas is in the range 0.6–1.5 μSv/h. The absence of vegetation on the surface allows erosion of the material by wind and water and its subsequent transport to the areas of the Shekaftar and Sumsar settlements and the adjacent Ferghana valley. The disposal sites located on the banks of the Sumsar river have been intensively eroded by the river, with consequences for the population of the village of Sumsar, immediately downstream, and other villages beyond. Water samples collected from the Sumsar river upstream and downstream of the mining sites clearly indicated significant and continuous uranium leaching from the sites into the river.
The main risks at Shekaftar are from exposure of the population to radon, gamma radiation from the freely accessible disposal sites, direct ingestion and inhalation of contaminated material; and by unauthorized use of contaminated materials for construction purposes. There is also uncontrolled transport of contaminated material by fluvial erosion, leading not only to pollution of the water downstream but also to deposition of contaminated sediments at the shoreline.

Close to the Shekaftar site are disused facilities from the mining and milling of polymetallic lead and zinc ores in Sumsar, including three tailing piles, containing salts of chemical contaminants including toxic heavy metals and metalloids, which are also released into the Sumsar river. As these are subject to similar problems and affect the same environment as the Shekaftar site, there may be merit in addressing the two sites together.

**Tajikistan**

All uranium mining in Tajikistan was carried out in the North-Eastern, Sugd region of the country (see Figure A6). A plant for processing uranium ores was also established there in 1946 at Chkalovsk, a small town close to Khujand city. A large proportion of the uranium ore processed in the country was imported from Kyrgyzstan, Uzbekistan and Kazakhstan, and from eastern European countries. This is a seismically active, mountainous area that drains to the Syr-Darya river.

The key uranium legacy sites of Degmay/Buston², Istiqlol and Adrasman are described in more detail below.

![Figure A6. Locations of uranium legacy sites in Tajikistan².](image)

Adapted from maps provided by the UN Geospatial Information Section.

² Istiqlol and Buston were formerly known as Taboshar and Chkalovsk, respectively.
Buston industrial complex

Buston (formerly Chkalovsk) is a suburb of the city of Khujand, the capital of the Sogdian province. The population of the wider Khujand area is more than one million. Buston is the location of several mining industries, including Vostokredmet (former Leninabad Mining Chemical Complex), which was previously involved in the milling and processing of uranium ores. Residues from the uranium extraction process and acid residues following neutralization were transported and deposited in the nearest tailings disposal site by pumping through an existing coal slurry pipeline. In the outskirts of Buston, there are three tailings sites: Degmay, Gafurov and Karta 1-9.

Degmay tailings dump

The Degmay tailings dump, which was operational from 1963 to 1993, is one of the largest tailings dumps of uranium mining wastes in Central Asia. It is located in the depression of the Degmay valley, 1.5 km to the south of the nearest settlement, Gaziyon, and approximately 10 km from Khujand city (Figure A7). The facility was established in 1963, when uranium ore processing activities were consolidated in the Leninabad Mining-Chemical Combine enterprise in Buston (formerly Chkalovsk). Most of the feed ore came from the uranium mines of Istiqlol (formerly Taboshar) and Adrasman in Tajikistan; Mailuu-Suu in Kyrgyzstan; Uigursai, Northern and Southern Bukinai and Beshkak in Uzbekistan; and Karamurun in Kazakhstan. The hydrometallurgical wastes were transported from the factory via pipelines to the Degmay tailings site. Following the independence of Tajikistan (1992), and particularly after 1995, the volume of uranium ore for processing decreased to such a level that, by 1999, uranium processing became uneconomical and the uranium ore processing line was closed. Processing of other metals continues.

The tailings dump was constructed by blocking a natural depression with a earthen dam 1 800 m in length and covering the bottom with a layer of bitumen 8 mm thick. The dam is located 5 km from the Syr-Darya river, approximately 200 m above the river. Currently, the height of the dam is 40 m, and the surface area of the tailings dump is more than 90 ha. The dump is filled to 83% of its capacity and contains about 36 million tonnes of hydrometallurgical wastes. The total activity is estimated to be about 150 TBq.

The tailings pond was partially covered with water until the 1990s. This gradually receded due to high evaporation and no (or very limited) discharge from the plant. The drying of the tailings enhanced the separation of the finer component (slimes) in the central part of the pond from more coarse components. This has resulted in the development of deep, quasi-hexagonal desiccation cracks, between 0.3 m and 2.0 m wide, and 1–4 m deep, which serve as pathways for radon exhalation.

In this portion of the impoundment $^{222}$Rn exhalation rates of 36–65 Bq/m²·s have been measured (during the summer); the ambient $^{222}$Rn concentration is in the range 200–12 000 Bq/m³. Gamma dose rates measured over the tailings surface in 2006 were in the range 4.5–20.0 μSv/h. Gamma dose rates measured by the State Enterprise Tajredmet in 2009 were in the range 2.5–3.0 μSv/h.

The dry tailings surface is exposed to re-suspension by wind, and, due to lack of any cover, provides a continuous source of contaminated dust. Cane was planted on the tailings pond in the 1990s to try and prevent resuspension of contaminated material. About 10% of the tailings area has recently been covered to reduce the level of resuspended material in response to public concerns and there are plans, and funding available, to cover a further 20%.

There is a bottom seepage discharge pipe in the impoundment, which ends at the dam toe in a collector pond, from which the collected seepage is returned to the tailings pond. At present no seepage is being collected at the dam toe (the seepage discharge pond is dry) and it appears that the bottom drainage pipe is not in working condition. Groundwater contamination therefore represents an additional radiological risk, with uncontrolled leakage...
of contaminants through the bottom of the tailings pond. The dry valley below the tailings dam leading towards the river is used as a dump for municipal waste.

Karta 1 – 9 (also known as the Chkalovsk (now Buston) tailings site)

The Karta 1-9 tailings site lies in the immediate vicinity of the city of Khujand, next to the international airport. As the city expands it is likely that the tailings site will soon be within the city limits. The site was operational from 1945 to 1963 and consists of nine tailings dumps, occupying an area of 18 ha and containing over 3 million tonnes of uranium tailings, as well as deposits of toxic arsenic and vanadium wastes.

The site has never been properly remediated. The International Atomic Energy Agency (IAEA) has made recommendations for remediation. However, due to a lack of funds by the Tajik state owner, practical measures were not implemented, and the site has remained unmarked and open to the public. In the winter of 2013/2014, at the urgent request of the Tajik Nuclear and Radiation Safety Agency (NRSA), the Swiss Foundation for Mine Action (FSD) built a 1.8 km long concrete wall, more than two meters high, around the entire tailings siteto limit access by people or animals. The project cost approximately US $200 000, and was carried out jointly with Green Cross Switzerland and Swiss cities and cantons, in cooperation with the site owner and state company Vostokredmet. The work was coordinated with NRSA, the state regulator.

The Tajik authorities also approached FSD at this time to remediate the site. The FSD project is in its initial stage and, as well as the complete remediation of the Karta 1-9 site, includes the removal of industrial wastes and the remediation of contaminated areas within the Tajredmet hydrometallurgical plant. As part of this project, an EIA/FS is planned for 2017.

Gafurov

The tailings site at Gafurov is located 5 km west of the settlement of Gafurov and some 10 km away from Degmay. The site is adjacent to a main road with apartments blocks less than 50 m away and a railway station within 150 m. The site was in operation between 1945 and 1950, during the same period as the so-called Experimental Hydro-metallurgical Plant. The site extends over 5 ha, is approximately 13 m high and contains some 400,000 tonnes of residues including tailings, waste rock, scrap metal and decommissioned machines. It is covered with sedimentary material, comprising gravel and cobble-sized stones and sand in a silt-clay matrix, which is between 1 and 2 meters thick. The heap was constructed on the natural land surface without any special site preparation.

The remediation already undertaken of this tailings site is considered by the regulatory authority, NRSA, to be adequate and broadly in accord with good international practice; confirmation by an independent evaluation would, however, add to public confidence.

Khujand mine No. 3

The waste rock piles of the former uranium mine no. 3 are located 4–5 km from the residential part of the city of Khujand along the slope and foothills of Mogoltau. Uranium mining took place in this area between 1976 and 1985. The total area covered by the waste rock piles is about 6 ha and the piles contain about 350 000 tonnes of waste rock.

The waste rock piles have a soil cover of 0.5–0.7 m in thickness. The gamma-dose rate on the surface of the waste rock piles is in the range of 0.3–0.6 μSv/h, indicating that the cover is adequate, at least from the perspective of limiting external radiation. The adequacy of the remediation of the rock piles, more generally, warrants further investigation.

Mine waters discharging from the gallery have an increased content of radionuclides of the uranium-thorium series (e.g. containing 30-36 mg/l of uranium). For this reason, a mine water treatment facility, including sedimentation ponds and anion-exchange columns, was
installed at the end of the 1990s. This worked well, both in terms of environmental protection and the extraction of uranium from the mine water. However, in recent years, this treatment facility has been closed. Plans exist to re-commission the water treatment facility with the installation of new ion-exchange columns funded from national sources.

Istiqlol

The Istiqlol uranium mine is one of the oldest mines in the territory of the former Soviet Union. It was opened in 1936 and active mining took place from 1945 to 1965. The site is situated at the southern edge of the Kuramin mountains close to the Uzbek–Tajik border and only a few kilometres from Istiqlol village. The site extends over some 400 ha and is rather complex. It comprises a large open pit mine, abandoned mining adits, mines, seven waste rock piles, the abandoned structure and bunkers of the processing facilities for low grade ore, a pile of ground low grade ore remaining after leaching (Yellow Hill), and several tailings piles generated during the different developmental stages of the hydrometallurgical process for uranium extraction. Istiqlol village, with a population of about 14,000, is situated about 6 km downstream from the mines, and about 3 km downstream from the open in situ uranium extraction site (see Figure A7).

Uranium extraction was carried out in situ in concrete tanks by the heap leaching method. The ground light yellow residue material produced in this process, containing more than one million tonnes of low grade ore, was formed into a pile that is not covered. Local residents have access to the pile (Yellow Hill) and the material may have been used repeatedly for construction purposes. There is a tailings dump (L-3) containing about 1.2 million tonnes of waste, as well as dumps containing waste rocks and low grade ores in the surrounding area. The local school, previously the administrative building of Vostokredmet, is situated in the vicinity of waste rock deposits. The wastes have been exposed to wind and water erosion for more than 40 years. The radon exhalation in the area appears to be elevated. The gamma dose rate measured near Yellow Hill is 0.4–0.7 μSv/h and reaches up to 3.0–4.0 μSv/h in the places where uranium waste rock was dumped.

![Figure A7. Aerial view of Degmay and Istiqlol sites showing their locations relative to Khujand city and the Syr-Darya river. [21]](image-url)
The open pit mine is currently filled with water (from ground water and precipitation), and this pit lake (800 m length x 240 m width x 60 m depth) is utilized by the local community as a water reservoir, despite containing 47 000–60 000 Bq/m³ of uranium. Fish from the pit lake are consumed by local residents, and domestic animals such as cows, sheep and goats feed on the surrounding land and use the pit water for drinking purposes. The gamma dose rate at the pit is 0.48–0.56 μSv/h.

The facility is in the watershed of the mountain stream, Utkem-Say, at an elevation of 960 m. Mine water contaminated with uranium is discharged from two mine adits at a rate varying between 40 and 80 m³/h. This water flows towards and into Istiqlol village. The Archy Say tributary of the Utkem-Say runs across the site and receives released tailings material, mainly from the waste rock piles and the ground low grade ore pile (the ‘yellow hill’). Heavy rains from 1998 to 2000 resulted in mudslides that caused significant amounts of tailings to be released into the valley of the other stream close to the site, the Sarym Sakhly Say. At the foothills of the Kuramin mountains, the torrential fluctuations of the Utkem-Say are controlled by a retention dam. From here the river flows westward between the Kuramin and Mogol mountain ranges to reach the agricultural area above Obburdon about 15 km away, where the water is fully utilized for irrigation. The irrigated agricultural plains extend as far as the Syr-Darya river (about 28 km from the Utkem-Say, in Uzbekistan).

Adrasman

A uranium extraction plant operated in the town of Adrasman. The main legacy at this site is a tailings dump containing approximately 800 000 tonnes of waste material. The tailings are located on the western outskirts of the town and were covered relatively recently by SE Vostokredmet, with 0.4–0.6 m of waste rock and soil, the material having been obtained from local sources. The gamma dose rate, as measured by “Vostokredmet” on the top of the tailings cover, is in the range 0.3–0.4 μSv/h.

The tailings dump is not fenced off and people living in the nearby settlement have unrestricted access to the site, which they frequently visit. A 2 m deep ravine has developed in the tailings due to water erosion. Reportedly, seepage water comes out of the tailings dump during the rainy season and is used by the local population for irrigating the outlying vegetable gardens. Transport of radioactive materials in seepage water is possible along the Karamazar river which discharges into the Syr-Darya river.

In 2010, major erosion of the conserved tailings occurred. Tailings were released beyond the dam wall and were subsequently dispersed over adjacent areas. Further dispersion of this material continues and there is a risk that it will reach nearby rivers. Emergency measures were taken in 2013 to constrain the more widespread dispersion of the material. As a result of these events, the level of priority assigned to remediating this site in the national concept for remediation [10] was significantly raised [16, 12].

Uzbekistan

For more than 40 years Uzbekistan was one of the main producers of raw material in the uranium industry in the former Soviet Union. A great number of large uranium deposits, with a relatively high uranium content (from 0.02%, but up to 12.8 – 18.3%), were discovered in the area of the Syr-Darya and Amu-Darya rivers. In total, 24 uranium deposits were discovered and prospected in the country, with the main deposits situated near the populated areas of Uchkuduk, Zarafshan, Zafarabad, Nurabad, Angren, Charkesar and Krasnogorskiy.

Between 1964 and 1995, uranium mining in Uzbekistan was conducted using conventional mining methods. Ores were mined, sorted and then sent for processing, with the waste from sorting activities stored on the mine sites. The ore from the mines in the mountainous eastern part of the country, such as Yangiabad (Tashkent district) and Charkesar in the Ferghana
valley (Namangan district), was processed in the Leninabad Mining Chemical Industrial Combine (now the State Enterprise Vostokredmet) in Khujand, in Tajikistan. The ore from the sandstone type uranium deposits in Central Kyzylkum (Navoi and Samarkand region) was processed at the Navoi Mining Chemical Industrial Combine (NMCC) in Uzbekistan. Consequently, the only uranium tailings in Uzbekistan are at the NMCC site. There are also piles of low grade ores from areas of initial mining in the Central-Kyzylkum region, which were mainly transported into the suburbs of Uchkuduk, where they were dumped (see Figure A9 for locations of the main sites).

All conventional uranium mines (open pit and underground) were shut down with the introduction of in situ leaching (ISL) in 1995. Thus, a significant part of the low grade ores and waste in uranium mining and processing facilities, which contain various concentrations of uranium, thorium and their decay products, originated from earlier activities.

![Figure A8. Locations of uranium legacy sites in Uzbekistan. Adapted from maps provided by the UN Geospatial Information Section.](image)

Prior to 1992, almost no measures were taken to remediate tailings in the Central-Kyzylkum region partly because of the very low population of the area. Since that time, several projects have been developed in Uzbekistan aimed at the re-cultivation of contaminated land and former waste dumps where uranium enterprises were situated.

Most sites are owned by and are the responsibility of active uranium producers, such as NMCC. The large uranium tailings impoundments at Navoi, for example, are being covered using non-radioactive gold tailings from the nearby hydrometallurgical plant, which has switched from the processing of uranium to gold ore. Only the two former mine sites of Yangiabad and Charkesar (not in operation and/or in private ownership) fall into the category of uranium legacy sites.
Yangiabad

The Yangiabad site is located in the Dukentsay valley in the north-eastern part of the Chatkal mountain ridge of the western Tin Shan mountains. It is in the Akhangaran district of the Tashkent region, which is an area with high seismic risk. Uranium mining activities were carried out just above the town of Yangiabad for 40 years. The Yangiabad mine and the associated waste rock piles extend over an area of 50 km² and contain about 2.6 million m³ of radioactive waste. This is a mountainous region, characterized by narrow valleys and steep valley slopes. The ore processing plant (Y5) is located at the bottom of a river valley, but the other 6 legacy sites of Yangiabad stretch from the valleys to higher altitudes on mostly steep mountain slopes (see Figure A9).

Following closure of the mine in the 1980s, the population of the area declined to about 780 inhabitants, about 10% of its former level. Most people live in the town, with the remainder spread over the surrounding valleys. Shepherds live in the mountains between March and November. There is no industry, and small-scale pasture and horticulture dominate the economy; although an increasing number of tourists visit the area for skiing, trekking and adventure holidays. The National Boxing Centre, where a number of young sportspersons are trained, is also located in Yangiabad.

The area of Yangiabad is characterized by small rivers (Alatanga, Chilten, Dukentsay, Kattasay and Dzhekindek), which join the Dukent river in Yangiabad. The Dukent river flows further in a southerly direction towards Angren City. These rivers flow throughout the year, but during snowmelt their water levels rise and flow rate increases. Soil erosion takes place continuously and increases during snowmelt.

The water supply for Yangiabad is derived from fresh water taken from natural springs and different rivers upstream of the legacy sites, using a system of steel pipes built during the mining period. There is a small water bottling plant located on the Dzhekindek River immediately upstream of Yangiabad. Surface water bodies are used for livestock and for irrigation; shepherds use mine water collected from the mine adits.

Figure A9. Aerial view of the Yangiabad legacy sites in relation to the town of Yangiabad. [23]
There are seven distinct legacy areas around Yangiabad (see Figure A10) and four mine areas (Alatanga [Y1], Razveduchastok [Y2], Kattasay [Y3] and Dzhekindek [Y4]) located in the more remote steep mountain valleys. Each of these comprises waste rock dumps, mine shafts and adits. Some also contain ore bunkers, loading stations and sinkholes caused by collapsed underground mine workings. None of the objects have been rehabilitated. Most of the waste rock dumps have extremely steep slopes without vegetation and are subject to continuous erosion. The shafts and adits have generally been closed, but many of the adits have been re-opened illegally by scrap scavengers. Most of the brick or concrete buildings on the surface have been dismantled.

Many of the legacy sites are used for pasture. In some places, dose rates can reach up to 5 μSv/h. There is a new tourist base located in the former miner’s village of the Kattasay mine, and also a larger waste rock disposal site related to the Kattasay mine operation on the outskirts of Yangiabad village. Waste rock from this site was used as building material to stabilize the access road to the mine (and to the new tourist base) and the slopes. A dump was removed to create an artificial lake near the tourist base and there is an open adit at the lake shore.

The site of the ore processing plant at Rudny Dvor (Y5) is in the bottom of the valley, close to Yangiabad village and easily accessible. Waste rock has been dumped here at two levels on the bottom of the valley, with the dump foot located in the river. Erosion takes place continuously. Mine water flowing out through open adit portals infiltrates the disposed waste materials and migrates towards the Katta river.

The dose rate is up to 8.5 μSv/h locally on the surface of the ore material and is generally above 0.5 μSv/h. The uranium concentration of 20 μg/l measured in the river water downstream of the ore processing plant is significantly higher than the background level upstream in the Katta river.

The central waste rock dump site of the ore processing plant (Y6) consists of several dumps, from small to very large in size. The waste rock has been dumped in two side-valleys and on the slope of the Dukentsay valley. The base of the dump, where seepage water has been observed, reaches the main road connecting Angren to Yangiabad. There are two occupied buildings located above the site, accessible by a dirt road across the waste rock dump. The waste rock area has not been reclaimed, but has been partly covered by municipal wastes. Dose rates can reach up to 2 μSv/h.

The central dump for low grade ore (Y7) is very large. Low grade ore originating from the ore processing plant was dumped in a side-valley and on the slope of the Dukentsay valley. The base of the dump reaches close to the main road from Angren to Yangiabad. Municipal wastes and material from demolished buildings have been disposed on the site. Some occupied houses are located near the site, and the access road crosses the dump. Surface runoff ponding at the western end is infiltrating into the dump, and a significant volume of water is flowing out of the base of the dump and forming a creek. Elevated radon concentrations have been measured close to this base and to an occupied house. The dose rate is above 1 μSv/h over the entire area.

Charkesar

The Charkesar legacy site is located 140 km east of Tashkent and 20 km from the regional centre of Pap in Namangan district on the south-east slope of the Kuramin mountains. Two mines operated on the site — Charkesar-1 and Charkesar-2 (see Figure A11). Charkesar-2 is located in the valley of a small mountain river (Ingichka river) on the outskirts of Charkesar village, which has a population of a few thousand. Charkesar-1 is located 5–6 km to the west, in an arid, unpopulated valley in the highlands. Mining was conducted using conventional methods including underground leaching down to a depth of 280 m. After mine closure in 1995, most of the miners and professionals left the village because of lack of other work opportunities in the area. However, the local population is now growing, with a ‘new village’
having been developed along the Ingichka river, where there is fertile soil. The local economy is based largely on small-scale pasture, horticulture and handicrafts. Many residents travel to larger towns and cities for work.

Seven disposal sites have been identified in Charkesar-2, as well as three adits and two shafts. These objects are in the process of being remediated by the Government of Uzbekistan. In due course, when the ongoing remediation has been completed, consideration will be given to whether further remediation needs to be done under the Strategic Master Plan.

![Figure A10. Map of the Charkesar mine sites showing the populated areas nearby. [23]](image)

The Charkesar-1 mine is located in an arid highland valley near its entrance to the plain. The mine site extends about 1.5 km along the valley. All mine buildings have been demolished and the mine has been flooded. Some of the underground workings have collapsed or are still open, posing a risk to those visiting the site (mainly shepherds with their livestock). Mine water is discharged from one of the adits. Waste rock and low grade ore was disposed of in seven dumps and smaller disposal sites in depressions in the sides of the valley. These are covered with sparse vegetation. None of the legacy objects have been remediated. The waste is composed of crushed granite rock and granodiorites of various rock sizes, and is well consolidated. In some places, the slopes of the waste dumps have been washed out by flood and rainwater, but transport by water erosion or by wind is limited due to the arid climate and absence of fine particles in the waste.

**Kazakhstan**

Around 20% of the world’s uranium reserves are concentrated in Kazakhstan. During the Soviet era and since Kazakhstan gained independence, the mining industry, and particularly uranium ore mining and processing, has been one of the country’s main industries.

A State-funded national programme for remediation of former uranium production sites in Kazakhstan began in 2001. The Ministry of Natural Resources was responsible for the programme, which was implemented by the State Enterprise Uranliquidrudnik. Remediation was carried out at nine mines in the north and south of the country (see Figure A11), with particular attention given during Phase 1 of the programme to remediation of mine shafts, adits, sinkholes, tailing piles and waste ore and rock dumps.
The programme was discontinued in 2010 and Uranliquidrudnik was dissolved in 2011 prior to the implementation of Phase 2. The second phase was intended to focus on decommissioning and demolishing of surface facilities and establishing post-remediation monitoring and surveillance programmes.

Despite extensive and largely successful remediation at the nine legacy sites, the programme failed to achieve a sustainable outcome owing to the remediated sites/objects not being placed under long-term institutional control. Other contributory factors included deficiencies in the regulatory framework for remediation, and the failure to transfer responsibility for the long-term management of the remediated uranium legacy sites (e.g. surveillance, monitoring and maintenance) to another body following the dissolution of Uranliquidrudnik. As of 2015, neither were the sites under proper regulatory control, nor was any monitoring or maintenance being undertaken. As a result, the efficacy and sustainability of the remediation work carried out has been degraded to varying extents and will need to be addressed.

![Figure A11. Locations of uranium legacy sites in Kazakhstan. Adapted from maps provided by the UN Geospatial Information Section.](image-url)

IAEA expert missions were conducted in 2014 and 2015 to assist the Government of Kazakhstan in developing a post-remediation long-term stewardship programme for these sites.

The following were the main recommendations of these missions:

- A long-term national strategy should be developed for the management of uranium legacy sites;
- The regulatory framework for remediation and long-term management of uranium legacy sites should be reviewed and, if necessary, enhanced;
- Proper institutional control (regulatory control and technical supervision) over uranium legacy sites should be restored;
• A strategy should be developed to repair damage to previously remediated sites (in particular, restoration of damaged covers of tailings and waste rock piles, improvement of drainage systems, installation of signs and fences, etc.) and to complete any unfinished remediation work;

• Arrangements should be made for the long-term care and maintenance of the sites — the development of local infrastructure at settlements near legacy sites could be advantageous in this respect and improve socioeconomic conditions more generally;

• Consideration should be given to socioeconomic development for local communities to support the need for long-term institutional control and care and maintenance of former uranium production sites.

Based on these recommendations, an action plan and budgetary proposal has been prepared for the Government of Kazakhstan to allocate funds for the dismantling and decommissioning of surface facilities, site clean-up, restoration of institutional control and establishment of a long-term monitoring and stewardship programme for these legacy sites.
Appendix B.
Evaluation of Risks and Remediation Options

This Appendix summarizes the main outcomes (or status) of systematic and comprehensive evaluations that have been made (or are being made or planned) of the risks and options for remediation of uranium legacy sites (or objects within them) in Kyrgyzstan, Tajikistan and Uzbekistan.

Kyrgyzstan

Mailuu-Suu

A systematic and comprehensive evaluation of the risks and options for the remediation of the Mailuu-Suu site is being carried out with support from EU’s INSC [18]. This evaluation is scheduled for completion by the second quarter of 2019, at which time detailed technical specifications (suitable for tendering purposes) will be available for the proposed remediation options. The plan foresees a decision in the third quarter of 2019 on if and when to fund/remediate Mailuu-Suu, taking account of the availability of funds and competing priorities.

Min-Kush

Two systematic and comprehensive evaluations have been made of the risks and options for the remediation of the Min-Kush site or objects within it: the first [19], undertaken with support from the EU’s INSC, covered the entire site, while the second [13], undertaken with support from the CIS programme, was limited to the tailings ponds. The proposed options for remediation of mine openings, waste rock dumps and processing facilities on the Min-Kush site, as assessed in the INSC supported project, are summarized in Table B1, and for the remediation of tailings ponds for both the INSC- and CIS-supported projects in Table B2.

The options proposed in the two studies for remediating the tailings ponds are broadly comparable, apart from the pond at Taldy-Bulak. Both studies propose the relocation of tailings from Tuyuk-Suu to Danlee and in situ remediation of tailings at Kak. The INSC-supported project proposes in situ remediation of the tailings at Taldy-Bulak, whereas the CIS project proposes their relocation to Dalnee.

In the investigations carried out by the CIS project, a significant risk of dam failure, related to the surrounding geology at Taldy-Bulak, was identified. The magnitude of the risk was sufficient to justify the relocation of the tailings from Taldy-Bulak, albeit at greater cost. New roads will need to be constructed for the transport of the tailings being relocated from Tuyuk-Suu and Taldy-Bulak to Danlee. The estimated costs in the two studies (about €17 million and €20 million for the INSC and CIS evaluations, respectively) are broadly comparable when account is taken of the additional costs of relocating tailings from Taldy-Bulak in the CIS proposal. The Tuyuk-Suu tailings pond is the highest priority object for remediation at Min-Kush owing to its insufficient geotechnical stability and the expected severe consequences of a tailings dam failure for the local population and the environment more generally.

Kyrgyzstan has decided to proceed with remediation of the tailings ponds at Min-Kush in accordance with the option proposed in the CIS study and with financial support from the CIS programme. Remediation is expected to begin in 2018 and to be completed within 6 years at an estimated cost of about ₽ 1.5 billion (€23 million).

1 Based on exchange rate of 63.98 RUB/€ (January 2017).
Table B1. Proposed remediation of mine openings, waste rock dumps and processing facilities at Min-Kush (INSC project)

<table>
<thead>
<tr>
<th>Object</th>
<th>Proposed remediation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plostshadka 17</td>
<td></td>
</tr>
<tr>
<td>Adit no. 8</td>
<td>Closure wall and crushed rock</td>
</tr>
<tr>
<td>Adit no. 9</td>
<td>Closure with crushed rock</td>
</tr>
<tr>
<td>Waste rock dump no. I</td>
<td>Water drainage trench</td>
</tr>
<tr>
<td>Buildings</td>
<td>Demolition and in-situ dump</td>
</tr>
<tr>
<td>Plostshadka 21</td>
<td></td>
</tr>
<tr>
<td>Ventilation shaft no. 1</td>
<td>Concrete slab</td>
</tr>
<tr>
<td>Shaft no. 3</td>
<td>Concrete slab</td>
</tr>
<tr>
<td>Adit no. 2</td>
<td>Adit closure with fluid concrete</td>
</tr>
<tr>
<td>Plostshadka 21 bunker</td>
<td>Demolition and in-situ dump</td>
</tr>
<tr>
<td>Waste rock dump no. II</td>
<td>Water discharge reconstruction</td>
</tr>
<tr>
<td>Buildings</td>
<td>Demolition and in-situ dump</td>
</tr>
<tr>
<td>Ak-Ulak and Rudny Sklad 6</td>
<td></td>
</tr>
<tr>
<td>Ventilation shaft no. 2</td>
<td>Shaft filling and concrete slab</td>
</tr>
<tr>
<td>Adit 4 Yuzhnaya and sinkholes 1, 2, 3</td>
<td>Filling with concrete and crushed rock</td>
</tr>
<tr>
<td>Sinkhole 7</td>
<td>Closure with surface concrete plug</td>
</tr>
<tr>
<td>Sinkholes 10, 11</td>
<td>Closure with surface concrete plug</td>
</tr>
<tr>
<td>Sinkhole 12</td>
<td>Closure with surface concrete plug</td>
</tr>
<tr>
<td>Waste rock dump no. XIX</td>
<td>Surface water diversion</td>
</tr>
<tr>
<td>Rudny Sklad 6</td>
<td>Excavate contaminated soil, cover</td>
</tr>
<tr>
<td>Buildings</td>
<td>Demolition and in-situ dump</td>
</tr>
<tr>
<td><strong>Processing site</strong></td>
<td></td>
</tr>
<tr>
<td>Bunker</td>
<td>Demolition and in-situ dump</td>
</tr>
<tr>
<td>Mill</td>
<td>Demolition and in-situ dump</td>
</tr>
<tr>
<td>Other buildings</td>
<td>Demolition and in-situ dump</td>
</tr>
<tr>
<td><strong>Other locations</strong></td>
<td></td>
</tr>
<tr>
<td>Buildings</td>
<td>Demolition and in-situ dump</td>
</tr>
</tbody>
</table>

Table B2. Proposed remediation of tailings ponds at Min-Kush (INSC and CIS projects)

<table>
<thead>
<tr>
<th>Tailings pond</th>
<th>Proposed remediation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INSC</strong></td>
<td><strong>CIS</strong></td>
</tr>
<tr>
<td>Tuyuk-Suu</td>
<td>Relocation to Dalnee</td>
</tr>
<tr>
<td>Taldy-Bulak</td>
<td>In situ remediation, cover, dam buttress</td>
</tr>
<tr>
<td>Kak</td>
<td>In situ remediation, cover</td>
</tr>
<tr>
<td>Dalnee</td>
<td>Transfer of tailings from Tuyuk-Suu, in situ remediation — cover, dam buttress, etc</td>
</tr>
</tbody>
</table>
The plan foresees a decision in the third quarter of 2017 on if and when to fund/remediate the other objects on the site (i.e., those listed in Table B1) taking account of the availability of funds and competing priorities. Remediation of these other objects is expected to take one to two years at an estimated cost of €3.4 million.

**Kadji-Say**

A systematic and comprehensive evaluation has been carried out, with support from the CIS programme, of the risks and options for the remediation of the waste piles at Kadji-Say. The proposed option is in situ remediation of the tailings. The estimated cost is ₽ 97 million (€1.5 million). The remediation work was scheduled to begin in the second quarter of 2018 and to be completed within about one year.

A few buildings remain on site and will need to be demolished and disposed of to complete the remediation of this site.

**Shekaftar**

A systematic and comprehensive evaluation of the risks and options for the remediation of the Shekaftar site has been undertaken with support from the EU’s INSC [19]. The proposed options for remediation of mine openings and waste rock dumps on the Shekaftar site are summarized in Table B3. The central waste rock dumps are located in residential areas, in close proximity to schools and other buildings. Their relocation to a more remote site was judged to be preferable to in situ remediation — in particular in terms of improved public perception, reduced likelihood of public access and reduced potential for exposure to radiation. Waste rock dump no. 3 is located next to the Sumsar river and there is a continuing risk of erosion of material into the river in the event of any breach or failure of existing buttresses. The relocation of this rock dump to a more remote site will remove the risk and presents a more sustainable solution.

<table>
<thead>
<tr>
<th>Object</th>
<th>Proposed remediation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shaft no. 1</td>
<td>Shaft filling and concrete slab</td>
</tr>
<tr>
<td>Shaft no. 2</td>
<td>Shaft filling and concrete slab</td>
</tr>
<tr>
<td>Shaft no. 3</td>
<td>Shaft filling and concrete slab</td>
</tr>
<tr>
<td>Shaft no. 5</td>
<td>Shaft filling and concrete slab</td>
</tr>
<tr>
<td>Shaft no. 6</td>
<td>Shaft filling and concrete slab</td>
</tr>
<tr>
<td>Shaft no. 7 and loading station</td>
<td>Shaft filling and concrete slab</td>
</tr>
<tr>
<td>Central waste rock dumps (I, II, V, VI, VII)</td>
<td>Relocation to mine site no. 4</td>
</tr>
<tr>
<td>Waste rock dump no. III</td>
<td>Relocation to mine site no. 4</td>
</tr>
</tbody>
</table>

The plan foresees a decision in the third quarter of 2017 on if and when to fund/remediate this site taking account of the availability of funds and competing priorities. Remediation is expected to require two to three years at an estimated cost of €2.9 million.

**Tajikistan**

**Buston industrial complex**

a) **Degmay**

A systematic and comprehensive evaluation of the risks and options for the remediation of the Degmay site is being carried out with support from the EU’s INSC [21]. The evaluation of

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1 Based on exchange rate of RUB 63.98/€ (January 2017).
options and costs is scheduled for completion in the third quarter of 2017 and the project as a whole is scheduled for completion by early 2018, at which time detailed technical specifications (suitable for tendering purposes) will be available for the proposed remediation option/s.

The plan foresees a decision in the third quarter of 2018 on if and when to fund/remediate the Degmay site, taking account of the availability of funds and competing priorities.

b) Karta 1–9 (sometimes referred to as Chkalovsk 1–9)

A systematic and comprehensive evaluation of the risks and options for the remediation of the Karta 1–9 waste dumps is foreseen by FSD sometime in 2017. The focus will be on Karta 1–9, but the scope of the evaluation will be extended to include industrial wastes at the Tajredmet hydro-metallurgical plant and some ‘hot spots’ of radioactive contamination.

Subject to the completion of the evaluation for Karta 1–9, the plan foresees a decision sometime in 2018 on whether and, if so, when to fund/remediate these objects taking account of the availability of funds and competing priorities.

c) Khujand

While remediation of this site is foreseen in both the national concept [10] and the programme for its realization [16], no systematic and comprehensive evaluation appears to have been made of the risks and options for remediation of this site as a whole. The Plan foresees a decision in the fourth quarter of 2018 on whether to initiate such an evaluation for waste rock piles at Khujand; national plans already exist to re-commission a water treatment facility to decontaminate mine waters at this site.

Istiqlol

Two systematic and comprehensive evaluations are being made of the risks and options for the remediation of the Istiqlol site or objects within it. The first, being undertaken with support from the CIS programme [13], is limited to Yellow Hill and tailings piles 1–4 while the second, being undertaken with support from the EU's INSC [19], covers the whole site.

The remediation option proposed in the CIS study [44] is to re-contour and cover the ‘yellow hill’ (in the process, significantly reducing its height) and improve the existing covers of the tailings piles 1–4, as illustrated in Figure B1. A preliminary estimate of the cost of the proposed remediation is about ₽ 0.8 billion (€12 million)¹ but there are indications that the final cost may be larger. The INSC evaluation is at a formative stage but indicative; preliminary estimates of the cost of remediating these objects are almost a factor of two greater than estimated in the CIS study.

![Figure B1. Istiqlol Yellow Hill before and after proposed remediation. [44]](image)

¹ Based on exchange rate of RUB 63.98/€ (January 2017).
Tajikistan has decided to proceed with remediation of Yellow Hill and the tailings piles 1–4 at Istiqlol with support from the CIS programme. The detailed design and specification of the proposed remediation will begin in the second quarter of 2017. Subject to regulatory approval in Tajikistan, the CIS Supreme Council is scheduled to make a decision on funding the proposed remediation in the fourth quarter of 2018. Subject to this decision, remediation is envisaged to begin in early 2019 and expected to take five to ten years, depending on the availability of funding.

The plan foresees a decision in the third quarter of 2018 on if and when to fund/remediate the other objects on the Istiqlol site, taking account of the availability of funds and competing priorities.

A water treatment facility is being designed and engineered to treat contaminated mine waters discharging from adits of an obsolete uranium mine on the Istiqlol site, with support from the EU’s INSC [22]. The aim is to treat the mine water so that it is safe to use for irrigating crops and consumption by people and livestock. The detailed design, costing and safety case were completed in 2017; construction of the facility is scheduled for 2018, with commissioning and operation foreseen early in 2019.

Adrasman

While remediation of this site is foreseen in both the national concept [10] and the programme for its realization [16], no systematic and comprehensive evaluation appears to have been made of the risks and options for the remediation of this site as a whole. The Plan foresees a decision in the third quarter of 2017 on if and when to initiate such an evaluation, taking account of the availability of funds and competing priorities.

Uzbekistan

Yangiabad

A systematic and comprehensive evaluation of the risks and options for remediation of the Yangiabad site has been undertaken with support from the EU’s INSC [23]. The proposed options for remediation are summarized in Table B4. The duration of the remediation work is estimated to be about three years at an estimated cost of €6.1 million.

<table>
<thead>
<tr>
<th>Object</th>
<th>Proposed remediation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Alatanga (Y1)</strong></td>
<td></td>
</tr>
<tr>
<td>2 shafts</td>
<td>Closure with reinforced concrete plate</td>
</tr>
<tr>
<td>2 sinkholes</td>
<td>Closure with surface concrete plug</td>
</tr>
<tr>
<td>4 adits</td>
<td>Closure with brick wall</td>
</tr>
<tr>
<td>1 adit</td>
<td>Closure with brick wall and discharge pipe</td>
</tr>
<tr>
<td>3 adits</td>
<td>Mine hazard signs</td>
</tr>
<tr>
<td>Waste rock dumps</td>
<td>Discharge channel for surface water</td>
</tr>
<tr>
<td>Processing facilities</td>
<td>Demolish with brownfield remediation</td>
</tr>
<tr>
<td>Alatanga River</td>
<td>Recreate river bed, river bank protection</td>
</tr>
<tr>
<td><strong>Razveduchavstok (Y2)</strong></td>
<td></td>
</tr>
<tr>
<td>2 shafts</td>
<td>Closure with reinforced concrete plate</td>
</tr>
<tr>
<td>2 adits</td>
<td>Closure with brick wall, water discharge</td>
</tr>
<tr>
<td>2 adits</td>
<td>Closure with brick wall</td>
</tr>
<tr>
<td>2 adits</td>
<td>Mine hazard signs</td>
</tr>
<tr>
<td>Object</td>
<td>Proposed remediation</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-----------------------------------------------------------</td>
</tr>
<tr>
<td>River</td>
<td>River bank protection</td>
</tr>
<tr>
<td><strong>Kattasay (Y3)</strong></td>
<td></td>
</tr>
<tr>
<td>6 sinkholes</td>
<td>Closure with surface concrete plug</td>
</tr>
<tr>
<td>6 adits</td>
<td>Closure with brick wall</td>
</tr>
<tr>
<td>3 adits</td>
<td>Sealing with fluid concrete</td>
</tr>
<tr>
<td>2 adits</td>
<td>Closure with iron grid, water discharge</td>
</tr>
<tr>
<td>1 adit</td>
<td>Covered by waste rock during central dump construction</td>
</tr>
<tr>
<td>2 rivers</td>
<td>River bank protection</td>
</tr>
<tr>
<td>Central waste rock dump</td>
<td>Relocate single dumps, cover</td>
</tr>
<tr>
<td><strong>Dzhekindek (Y4)</strong></td>
<td></td>
</tr>
<tr>
<td>2 adits</td>
<td>Mine hazard signs</td>
</tr>
<tr>
<td>1 sinkhole</td>
<td>Mine hazard signs</td>
</tr>
<tr>
<td><strong>Rudny Dvor (Y5)</strong></td>
<td></td>
</tr>
<tr>
<td>3 adits</td>
<td>Sealed with fluid concrete, water discharge</td>
</tr>
<tr>
<td>Processing facility</td>
<td>Demolition, brownfield remediation, 1 m cover, water discharge</td>
</tr>
<tr>
<td>River</td>
<td>River bank protection</td>
</tr>
<tr>
<td><strong>Central waste rock dump (Y6)</strong></td>
<td>Discharge channels for surface water at northern and southern parts</td>
</tr>
<tr>
<td>Surface water</td>
<td>Discharge channels for surface water at northern and southern parts</td>
</tr>
<tr>
<td>Waste rock dump containment</td>
<td>Gabion protection walls at northern and southern slopes along road</td>
</tr>
<tr>
<td><strong>Central low-grade ore dump (Y7)</strong></td>
<td>Discharge channel for surface water</td>
</tr>
<tr>
<td>Surface water</td>
<td>Discharge channel for surface water</td>
</tr>
<tr>
<td>Storage cell</td>
<td>Encapsulation of contaminated material from Rudny Dvor, with 5 m cover of waste rock</td>
</tr>
</tbody>
</table>

**Charkesar-1**

A systematic and comprehensive evaluation of the risks and options for remediation of the Charkesar-1 site has been carried out with support from the EU’s INSC [23]. The proposed options for remediation of the site are summarized in Table B5. The duration of the remediation work is estimated to be about one year at an estimated cost of about €0.3 million.

**Table B5. Proposed options for remediation of the Charkesar-1 mine**

<table>
<thead>
<tr>
<th>Object</th>
<th>Proposed remediation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 shafts</td>
<td>Closure with reinforced concrete plate</td>
</tr>
<tr>
<td>5 sinkholes</td>
<td>Closure with surface concrete plug</td>
</tr>
<tr>
<td>1 adit</td>
<td>Closure with waste rock, infiltration ditch for mine water</td>
</tr>
<tr>
<td>Abandoned facilities</td>
<td>Demolition</td>
</tr>
<tr>
<td>Small heaps of leached ore</td>
<td>Minor clean-up, concentration and coverage</td>
</tr>
</tbody>
</table>
Appendix C.
Good international practice in the evaluation of remediation options

Prior to carrying out any remediation work either of the entire ULS or any specific object within it, an evaluation must be made to understand the following, so as to define the preferred option, together with its costs, effects and risks:

- The existing situation (e.g. risks to people, animals, the environment, socioeconomic development);
- Whether remediation is needed;
- What remediation options are available;
- What the costs and benefits are (including the significant effects and risks) of these options;
- What the views of interested parties are.

Such an evaluation encompasses the processes required under radiological protection standards, as well as those of more general environmental impact assessment. These processes therefore need to be integrated, allowing interactions and iterations between the two aspects. The overall process is illustrated in Figure C1 below. Good international practice in carrying out EIA and the application of international radiological protection standards to the justification and optimization of remediation are considered separately in subsequent sections.

![Figure C1. Overall process for the evaluation of remediation options for ULS or specific risk objects](image)

Environmental Impact Assessment

The process of carrying out an environmental impact assessment is described in guidance developed by international organizations, such as the United Nations Environment Programme (UNEP). It is also described in international agreements and supranational legislation including the United Nations Economic Commission for Europe (UNECE) Convention on Environmental Impact Assessment in a Transboundary Context (‘Espoo Convention’) and the European Union Directive on Environmental Impact Assessment.
In addition, many national regulatory frameworks include a requirement and guidelines for carrying out an environmental impact assessment (EIA) as part of the approval process for projects that could affect the environment. While the specific legislative requirements do not necessarily apply\(^1\) in the context of this Strategic Master Plan, these references, or an equivalent methodology set out elsewhere that meets the same objectives, may be considered to describe good international practice.

Common features of an EIA include the following:

- It identifies, describes and appropriately assesses the significant effects of the project\(^2\) on:
  - Population and human health;
  - Biodiversity;
  - Land, soil, water, air and climate;
  - Material assets, cultural heritage and the landscape.

It also includes any interaction between these factors and any effects deriving from the risks of major accidents and/or disasters that are relevant;

- The documentation of an EIA typically includes:
  - A description of the project, comprising information on the site, design, size and other relevant features;
  - A description of the current environmental baseline and the likely significant effects of the project on the environment;
  - A description of the mitigation measures incorporated into the design of the project which will avoid, prevent or reduce and, if possible, offset likely significant adverse effects on the environment;
  - A description of the reasonable alternatives studied, which are relevant to the project and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the project on the environment;
  - A non-technical summary of the assessment;

- The public affected by the project should be given early and effective opportunities to participate in decision making on the project.

### Evaluation of remediation options

In accordance with internationally accepted radiological protection standards [IAEA BSS GSR Part 3], decisions about existing exposure situations, such as arise with ULS, should be governed by the principles (a) that remedial actions should be justified, and (b) that the choice of remedial actions from among those that are justified should be optimized.

\(^1\) Kazakhstan and Kyrgyzstan are parties to the Espoo Convention and both countries participated in a pilot project on the practical application of EIA in a transboundary context which led to revised guidelines on EIA in a transboundary context in Central Asia \([48]\).

\(^2\) While the focus of an environmental impact assessment is on the significant effects on the environment, the EIA process can often provide an opportunity for an integrated consideration of not only the environmental effects but also wider, positive and negative, social (e.g. health and safety of workers, community cohesion issues, effects on infrastructure and amenities) and economic effects of the project and its alternatives.
In applying these two principles, all relevant advantages and disadvantages of the identified remediation options should be taken into account. These include the following:

- Radiation doses that may be averted;
- Radiological and non-radiological risks;
- Environmental effects;
- Risks to the workers implementing the remedial measures;
- Economic costs;
- Improvement of the economic situation;
- Generation of residual materials including radioactive waste;
- Increased or reduced anxiety on the part of interested parties, and social disruption arising during and after the implementation of the remedial actions.

Identification of remediation options

Table C1 provides a summary of good practice for the assessment of whether, for each of the main areas of concern with uranium legacy sites, remediation would be justified and, if so, which of the main remediation options may warrant consideration.

Underpinning some of the key questions in the table are applicable national or international standards and reference levels, particularly for radiological protection and for (non-radiological) health and environmental standards. There is therefore a need within the feasibility study to identify and clearly set out the applicable international or national reference levels or standards. Relevant standards include those issued by the International Atomic Energy Agency and the World Health Organization.

In identifying options, guides setting out good practice for the management of tailings and waste rock from mining and milling activities and specifically for uranium mining activities may be helpful, although they are more relevant during mine operation. Such guides include the World Bank’s International Finance Corporation’s 2007 Environmental, Health and Safety Guidelines for Mining, the European Commission 2009 Reference Document on Best Available Techniques for the Management of Tailings and Waste-Rock in Mining Activities, the Leading Practice Handbooks published by the Government of Australia, and guidance issued by the IAEA. There is also some more specific guidance relating to structural issues published by the International Commission on Large Dams (ICOLD), as well as IAEA guidance addressing remediation of areas affected by past activities. These may be used, in particular, to provide an indication of some relevant general considerations for options relating to relocation or re-stabilization of waste facilities.
<table>
<thead>
<tr>
<th>Area of concern</th>
<th>Questions to be asked</th>
<th>Answers that drive the need for remediation</th>
<th>Comments, remedial options</th>
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<tr>
<td>Geotechnical stability</td>
<td>Is it possible (or even likely) that containment structures could fail and suddenly release wastes (e.g., tailings)? The risk may be exacerbated by landslides, mudflows, earthquakes for which Central Asia is known.</td>
<td>If the answer is yes, either remove the risk source or stabilize it. There may be specific technical requirements such as minimum stability factors (static, dynamic) of a dam or slope that must be complied with. Chains of cause &amp; effect events may need to be considered, e.g., a landslide leading to river blockage leading to ponding and rise of water level leading to dam destabilization.</td>
<td>In situ stabilization or relocation to a safer site (according to the risk assessment and the cost–benefit analysis). Geotechnical structures will usually require long-term after-care such as dam integrity/stability inspections for which sufficient budget must be allocated.</td>
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<tr>
<td>Erosion</td>
<td>Is it possible (or is it already happening) that rivers, heavy rainfalls, storm events erode wastes lead to uncontrolled dispersion of contamination?</td>
<td>As above Engineered hydraulic structures (drainage ditches, diversion channels and tunnels) need to be included in the risk analysis, as their failure (clogging of channels, collapse of water tunnels) may lead to failure of the dams, containments, and slopes.</td>
<td>As above. Stabilization measures may need aftercare/maintenance for which sufficient budget must be allocated. If there is the possibility of transboundary pollution (usually waterborne), this is a strong argument for remedial action. Even though actual pollution is negligible or barely measurable, it is the perceived pollution that may trigger conflict of disproportionate dimensions. Remedial action is then a way to reduce the potential of conflict that may lead to far greater cost than remediation.</td>
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<td>Radiation safety</td>
<td>Are doses due to the existing situation higher than a reference level (1–20 mSv/a)? Note that the reference level is usually at the lower end, i.e., 1 mSv/a. In some legislations the reference level may even be lower.</td>
<td>If the answer is yes, remedial action is required. Usually, the lower end of the 1–20 mSv/a range of the reference level is chosen because interested parties (a) feel safer and (b) authorities are less exposed to requests to justify higher reference levels. Remedial action may be required by national laws and regulations, in some cases independent of risk. Legal/regulatory requirements that are not based on risk but on derived quantities such as specific activity or radon exhalation rates may also be a justification of remedial action.</td>
<td>Remedial options may involve institutional control and simple access control measures (fencing, warning signs, awareness programs not to use land or water). However these measures have proven to be unsustainable. Another remediation strategy may aim at interrupting the exposure pathway, e.g.: Cover placement on waste facilities, Pipelines for contaminated water that may be used as drinking water Treatment of contaminated water before it is discharged into the environment (note, however, that water treatment may be required for many years or even decades, which requires substantial financial, technical, institutional and human resources that may not be available). Barriers, covers, etc. will also require some degree of institutional control such as aftercare and inspection, and potentially corrective action in case of failure of non-compliance with performance criteria. More sustainable and expensive options aim at removing the contamination source, e.g.:  - Relocation of wastes to a safer site  - Excavation of contaminated soil and replacement by clean material.</td>
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<tr>
<td>Non-radiological environmental factors</td>
<td>Is soil, water or air (dust) quality negatively impacted by legacies so that they don’t meet minimum standards (e.g., drinking water quality, soil for agricultural use)?</td>
<td>Same as above.</td>
<td>Same as above.</td>
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<tr>
<td>Community safety</td>
<td>Could people (especially playing children) or livestock be harmed by unsecured infrastructure, mine openings (shafts, adits) or subsidences?</td>
<td>If the answer is yes, remedial action is required. Note that typical conventional safety risks are higher than radiation risks in the range of 1 mSv/a or even well below.</td>
<td>Stabilization or backfill are options that may be considered. Institutional control measures, warning signs, fences have proven ineffective and unsustainable.</td>
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<td>Regional development, availability of land</td>
<td>Does a facility sit on land that could be used for other purposes (e.g. agriculture, tourism)</td>
<td>If the answer is yes, remedial action may be considered. If the legal framework requires reclamation of land after the cessation of mining and return of the land to the community for beneficial after-uses, remedial action is required.</td>
<td>This aspect is typically relevant in densely populated areas with a scarcity of land for residential, industrial or agricultural after-use. The need for additional land and the potential for regional development should be realistically assessed especially if the land is scarcely populated, largely unfertile and with limited potential for regional development. In any case, remediation options depend on site-specific circumstances and should be designed so that they facilitate to the extent possible (and not hinder) the beneficial after-use intended by the community. If contaminated land can be transformed into an asset by remediation, remediation costs may be (partially) offset by the increase in land value and compensated with the sale of the land, especially in densely populated or industrial areas. However, in regions with less development potential this may not be the case.</td>
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### Area of Concern

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<td>Visual impact</td>
<td>Does a facility cause major visual disturbance?</td>
<td>If the answer is yes, remedial action may be considered. Comparison with other sites where remedial action has been taken due to landscape/visual considerations (e.g., Wismut) may drive decision</td>
<td>Integration of the facilities into the surrounding landscape (e.g., reshaping, placing a cover/vegetation) or complete removal, depending on degree of disturbance and local preferences</td>
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<tr>
<td>Risk perception</td>
<td>Does a facility cause major perceived risks, even though real risks are low or negligible?</td>
<td>If the answer is yes, remedial action may be considered. This aspect should be critically analysed on a case by case basis, in order to ensure rational use of resources and avoid misallocation.</td>
<td>Available remedial options depend on the site-specific circumstances.</td>
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</tbody>
</table>

### Notes:

1. There may be situations in which none of the criteria alone would justify remediation, however, a sufficient number of criteria taken together may justify remediation.

2. Long-term considerations should be included as well especially in the following areas of interest:
   - Geotechnical stability
   - Erosion
   - Radiation safety
   - Non-radiological environmental risks.

Typical time frames at uranium legacy sites range from 200 to 1000 years.
Broadly, it is good practice for waste disposal facilities for relocated material and improvements to existing disposal facilities to aim to:

- Ensure long-term physical and chemical stability;
- Prevent water erosion;
- Prevent creation of dust;
- Have a water management plan;
- Manage free water;
- Minimize the need for active institutional controls, but, if necessary, provide for ongoing monitoring;
- Have an emergency plan that identifies, assesses and manages continuing risks.

Guidance that may be helpful in identifying remedial options to address the physical risks from mine shafts, sinkholes and adits include those produced by the United States Natural Resources Conservation Service, and Indian and Northern Affairs Canada.

Evaluation of options

The evaluation should address both the justification and the optimization of the options. For each option, it should include:

- Estimates of the costs and other resources needed, including for any treatment, removal, transport and disposal of radioactive waste and other contaminated material;
- Estimated doses to workers and the public due to exposure before, during and after remediation;
- Overall safety issues during remediation;
- Available technologies;
- Considerations for monitoring and sampling;
- Amount of residual materials, including radioactive waste, that may be generated;
- Institutional controls required after implementation of the option, if applicable.

The options should be compared and the preferred option should be selected in a systematic and transparent way taking into account the factors evaluated above, as well as non-quantitative considerations such as social and political aspects. This will require the involvement of relevant interested parties.

Peer review

Peer review is the evaluation of work by one or more people of similar competence to the producers of the work (peers). It constitutes a form of self-regulation by qualified members of a profession within the relevant field. Peer review methods are employed to maintain standards of quality, improve performance and provide credibility. In academia, scholarly peer review is often used to determine an academic paper’s suitability for publication. Peer review can be categorized by the type of activity and by the field or profession in which the activity occurs, e.g. medical peer review.

The two main elements of peer review in the context of this Strategic Master Plan are:
• Competence — those carrying out peer review should be of similar competence and have similar relevant practical experience to those carrying out the work being reviewed;

• Independence — all members of the team carrying out the peer review should be independent of the organization and the personnel that carried out the work being reviewed. Real, potential, and perceived conflicts of interest should be considered.

The peer review report should include an appraisal of whether the work carried out is in accordance with good international practice and, if appropriate, opportunities for improvement in future work.

**Potentially Useful References**

**Environmental Impact Assessment**


**IAEA standards and guides**

**Standards**


Guides


INTERNATIONAL ATOMIC ENERGY AGENCY, Safety, Monitoring and Surveillance of Residues from the Mining and Milling of Uranium and Thorium, Safety Reports Series No. 27, IAEA, Vienna (2002).

INTERNATIONAL ATOMIC ENERGY AGENCY, Coordination Group of Uranium Legacy Sites (CGULS), Regulatory Basis for Remediation of Uranium Production Legacy Sites, Regulatory requirements: Best international practice and Guidelines documents. In preparation.

World Health Organization standards


Other guidelines relating specifically to mines and mine wastes


AUSTRALIAN GOVERNMENT, Leading Practice Sustainable Development Program for the Mining Industry (2016).

INTERNATIONAL COMMISSION ON LARGE DAMS (ICOLD), Tailings dam and environment, ICOLD, Paris (1996).
INTERNATIONAL COMMISSION ON LARGE DAMS (ICOLD), Monitoring of tailings dams, ICOLD, Paris (1996).

INTERNATIONAL COMMISSION ON LARGE DAMS (ICOLD), A guide to tailings dams and impoundments, design, construction, use and rehabilitation, ICOLD, Paris (1996).

INTERNATIONAL COMMISSION ON LARGE DAMS (ICOLD), Tailings dams, risk of dangerous occurrences, ICOLD, Paris (2001).


INDIAN AND NORTHERN AFFAIRS CANADA (INAC), Remediation Guidelines for Abandoned Mine Openings in Northern Canada (2011).