# THE NUCLEAR MATERIAL FOCUS AREA ROADMAPPING PROCESS UTILIZING ENVIRONMENTAL MANAGEMENT COMPLEX-WIDE NUCLEAR MATERIAL DISPOSITION PATHWAYS

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## ABSTRACT

This paper describes the process that the Nuclear Materials Focus Area (NMFA) has developed and utilizes in working with individual Department of Energy (DOE) sites to identify, address, and prioritize research and development efforts in the stabilization, disposition, and storage of nuclear materials. By associating site technology needs with nuclear disposition pathways and integrating those with site schedules, the NMFA is developing a complex wide roadmap for nuclear material technology development. This approach will leverage technology needs and opportunities at multiple sites and assist the NMFA in building a defensible research and development program to address the nuclear material technology needs across the complex.

## INTRODUCTION

The Nuclear Materials Focus Area (NMFA) conducts a research and development program to develop technologies to support the safe management and expeditious stabilization of nuclear materials, including spent nuclear fuel, managed by the Department of Energy (DOE) Office of Environmental Management (EM). The NMFA identifies and provides technical solutions to the broad range of challenges associated with the management of nuclear materials. Specifically, the NMFA conducts a research and development program with following objectives:

- Develop and deploy new technologies for nuclear materials stabilization and disposition;
- Enable progress towards meeting EM's site closure objectives;
- Develop integrated solutions to obtain both multi-site and multi-program benefits; and
- Provide research and development support for the DOE's responses to the Defense Nuclear Facilities Safety Board's recommendations.

### NMFA Roadmap Process

To facilitate the strategic planning associated with developing a program to prioritize and address both site and complex-wide technology development efforts, the NMFA has initiated the development of a roadmap. As a basis for integrating the program across the complex, the NMFA is focusing on the nuclear material disposition pathways at each site. In 1998, DOE's Office of Integration and Disposition (EM-20) undertook the task to identify DOE's nuclear materials inventories and to determine disposition paths for nuclear material excess of interest to the Office of Environmental Management.

The data on which these disposition maps are based was principally obtained as a result of efforts conducted by the EM Office of Nuclear Materials and Spent Nuclear Fuel Stabilization's (EM-21) Nuclear Materials Stewardship Program during the Nuclear Materials Integration (NMI) Project. The NMI efforts built upon work already performed or in progress at the time, such as: Defense Nuclear Facilities Safety Board recommendations 94-1 and 97-1 plans to accelerate the stabilization and disposition of high risk/vulnerability fissile materials; EM Integration project efforts in integrating the disposition of waste and spent nuclear fuel; EM Processing Needs Assessment to develop a listing of materials to examine future canyon facility needs at the Savannah River Site based on materials disposition paths; and the efforts at individual DOE sites to support the EM *Accelerating Cleanup: Paths to Closure* report.

During the NMI project, NMI teams worked with the various site personnel to identify a comprehensive inventory of nuclear materials either "owned" by EM, "owned" by other DOE programs but residing in EM facilities or sites, or expected to be transferred to EM ownership by the year 2015. The teams worked to develop life-cycle maps showing the summary disposition pathways for the various groupings, or streams, of nuclear materials at the sites. These pathways were then evaluated in terms of technical maturity, programmatic risk, and ES&H vulnerabilities. Many of the paths were also analyzed to identify alternative disposition pathways that may have presented opportunities for cost savings, schedule accelerations, and other program improvements. The overall results of these NMI project efforts were documented in Material Management Plans that were assembled for each of the main nuclear material types that were addressed by the project.

After the NMI project developed the nuclear materials disposition maps at the end of calendar year 1998, the hardcopy disposition maps were sent out the individual DOE sites for review and updating as part of the Spring 1999 *Paths to Closure* data call. The feedback received from the sites as part of this data call was incorporated into an updated set of nuclear materials disposition maps. Hardcopy maps were again sent out to the sites for review and updating as part of the Spring 2000 IPABS data call. The feedback received from the sites as part of the 2000 data call was also incorporated into an updated set of nuclear materials disposition maps.

At this point, efforts were begun to fully incorporate the nuclear materials disposition planning data into the IPABS electronic data system where the rest of the disposition planning data for EM's waste and spent nuclear fuel already resided. Once the appropriate modifications had been identified and made to the IPABS database structure, the data from the latest set of updated nuclear materials disposition maps was seeded into an electronic database and was uploaded into IPABS where it currently resides. This data can now be accessed in that system and updated by the sites as part of the annual Spring IPABS planning data update.

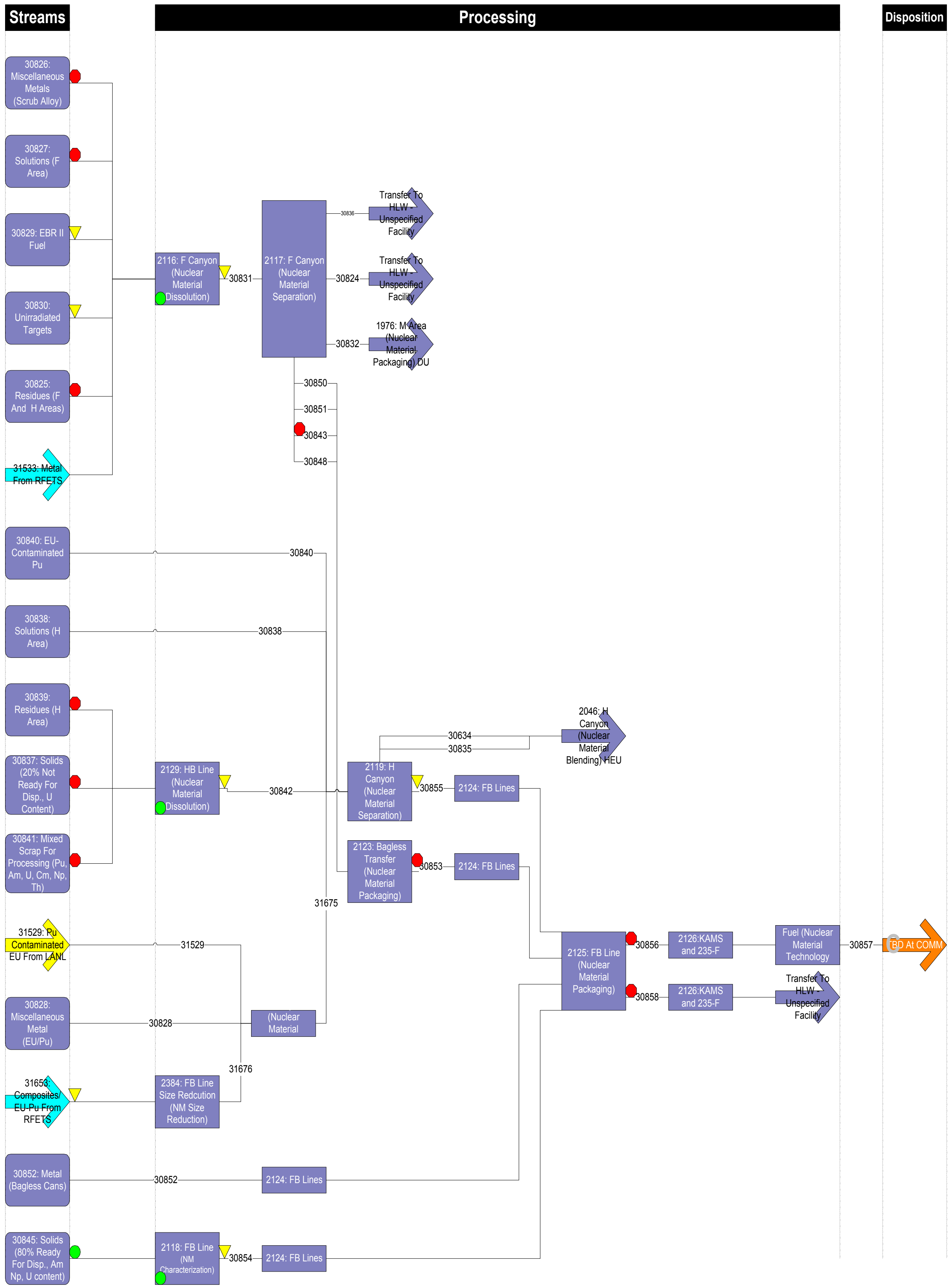


Fig. 1.1 Example Nuclear Material Stream Disposition Map

In addition to the basic pathway information for dispositioning nuclear material streams, other information and assessments regarding the programmatic risks associated with the disposition of the streams are also captured in IPABS. One of the programmatic risk factors has to do with technology. This technology risk factor reflects any need to develop or refine technologies to assist in dispositioning the streams. It is also a measure of the technical maturity of the dispositioning processes for the streams. These technology risks can be associated with the site technology needs that are identified at each site through the Site Technology Coordinating Groups and the site projects that have the technology need.

Over the past three years the NMFA has worked with the sites across the complex to identify technology and science needs related to the scope of the focus area during workshops held at each site (figure 1.2). Site need statements are developed to provide the Department of Energy (DOE) programs, researchers, and technology providers with information about programmatic science and technology gaps. These need fall into two categories: technology needs and science needs. Technology needs include descriptions and requirements for a component, process, system, or a set of systems that presently does not exist, but is critical to a site's ability to stabilize and disposition nuclear materials. Science needs are developed based on evaluations indicating there is sufficient foundational knowledge from which to develop necessary technologies or where there is a need to develop a better understanding of the underlying problem.

The science and technology needs statements are designed to provide sufficient detailed information to enable the focus area to understand the needs well enough to determine when different sites have the same need and initiate preparation of technical responses to satisfy them. The goal of each need statement is to define the need precisely, prioritize the need, identify schedule requirements and include a clear definition of successful resolution of the need. To date, over two hundred and fifty needs have been identified and categorized into one of the NMFA product lines; Stabilization, Packaging and Transportation, Materials Processing, Long Term Storage, and Spent Nuclear Fuel. Each Product Line Manager then works with the individual site need holders to address each need with a technical response. The technical response describes in detail what the focus area will do to address the need if sufficient funding exists. Once the needs have been developed and formalized, the NMFA works with each site to associate the need with the applicable nuclear material disposition pathway from the Stream Disposition Data (SDD) module in IPABS-IS. This has been done with each stream including but not limited to , Plutonium 238 & 239, Uranium233, Spent Nuclear Fuel, Americium, Curium, Neptunium, Highly Enriched Uranium, Low Enriched Uranium, Depleted Uranium, and Thorium. The stream disposition data is reviewed with the sites at this point during the process and all changes and corrections are noted. The NMFA then works with the sites to enter nuclear material stream data corrections into IPABS. The stream, need association is then recorded in a NMFA database for the intent of examining needs sets at other sites across the complex with the same nuclear material disposition pathway.

During the NMFA needs workshops across the complex, needs from other sites with the same nuclear material streams are review for applicability at each site (figure 1.3).

Programmatic milestones and timelines are then developed and summarized by disposition pathways at each site. The needs associated with each material stream pathway are then analyzed to incorporate earliest and latest dates technologies can be effective in resolving issues to meet site schedules and milestones. Technical risk mitigation, technology gap mitigation and alternative technologies are then identified and

| Need ID | Need Title |
|---|---|
| 00-01-18 | Thermodynamics of Complex Actinide Systems: Relevance to Long-Term Storage |
| 09-01-17 | Stress Corrosion Cracking of Stainless Steel in Nitric Acid / Halide Environments |
| 09-01-27 | Gas Generation Measurements for Nuclear Material Shipping Environments |
| 09-01-30 | Long-Term Gas Generation Surveillance for Stabilized Nuclear Materials |
| 09-01-36 | Nuclear Materials Deflagration Modelling |
| 09-01-38 | Moisture Analytical Methods for Nuclear Materials |
| 09-01-40 | Plutonium Materials Stabilization Process Qualification |
| 01-01-02 | Determination of Moisture Uptake Rates on Calcined Pu Oxides |
| 01-01-03 | Develop NDA Methods for Impurities in Pu Storage Containers |
| 01-01-05 | Establish ASME Equivalency for Closure Welds on Pu Storage Containers |
| 00-005 | Moisture Measurement on Stabilized Material for 3013 Container Storage |
| 00-006 | Long-Term Gas Generation Surveillance |
| 00-011 | Furnace Time Cycle Improvement - Plutonium Finishing Plant |
| 01-014 | Chloride wash process to pre-treat feed to thermal stabilization |
| 01-015 | Improved throughput instrumentation for NDA of SNM items |
| 01-017 | More accurate, quicker NDS of gloveboxes HVAC for Pu holdup |
| 01-019 | Ability to open pressurized 3013 containers |
| 01-020 | Item transfer method to replace current sealout techniques |
| 99-004 | Process Optimization – Extension of Plutonium Precipitation Process for Hanford's Plutonium Finishing Plant (PFP) |
| 5017 | Impact of Radiolysis Gas on Sealed Storage Containers |
| 5024 | Complete Material Identification and Surveillance Studies |
| 5026 | Life Storage and Shelf-Life Surveillance Program for Plutonium Packages |
| 5032 | Plutonium Surveillance and Validation of Models for Safe Storage |
| 5036 | Technical Basis to Model the Corrosion Tendencies of 3013 Canisters Stored in Building 105-K |
| 5038 | Understanding Radiolytic Gas Generation in Pure Plutonium Oxides |
| 5039 | Understanding Radiolytic Gas Generation in Impure Plutonium Oxides |
| 5040 | Understanding Radiolytic Gas Generation in Plutonium-Containing Residues |
| 5041 | Effective Dissolution of Refractory Mixed Scrap at SRS |
| 5043 | Aqueous Processing of RFETS Chloride-Containing Oxide Materials |
| 5044 | Aqueous Processing of Hanford Chloride-Containing Oxide Materials |
| 5045 | Moisture Analysis Methods for Small Samples |
| 5046 | Moisture Analysis Methods for Bulk Materials |
| 5047 | Determination of Moisture Readsorption on Impure Oxide Materials |
| 5048 | Prevention of Precipitation of Unwanted Salts During Dissolution |
| 5056 | Hydrogen Monitor for Dissolution and Process Off-gases |
| 6009 | Remote Pressure and Temperature Detection Device for Storage Cans |

Fig. 1.2, Example NMFA Needs

explored. Specific support activities to reduce project cost and schedule and to reduce ES&H impacts are also identified.

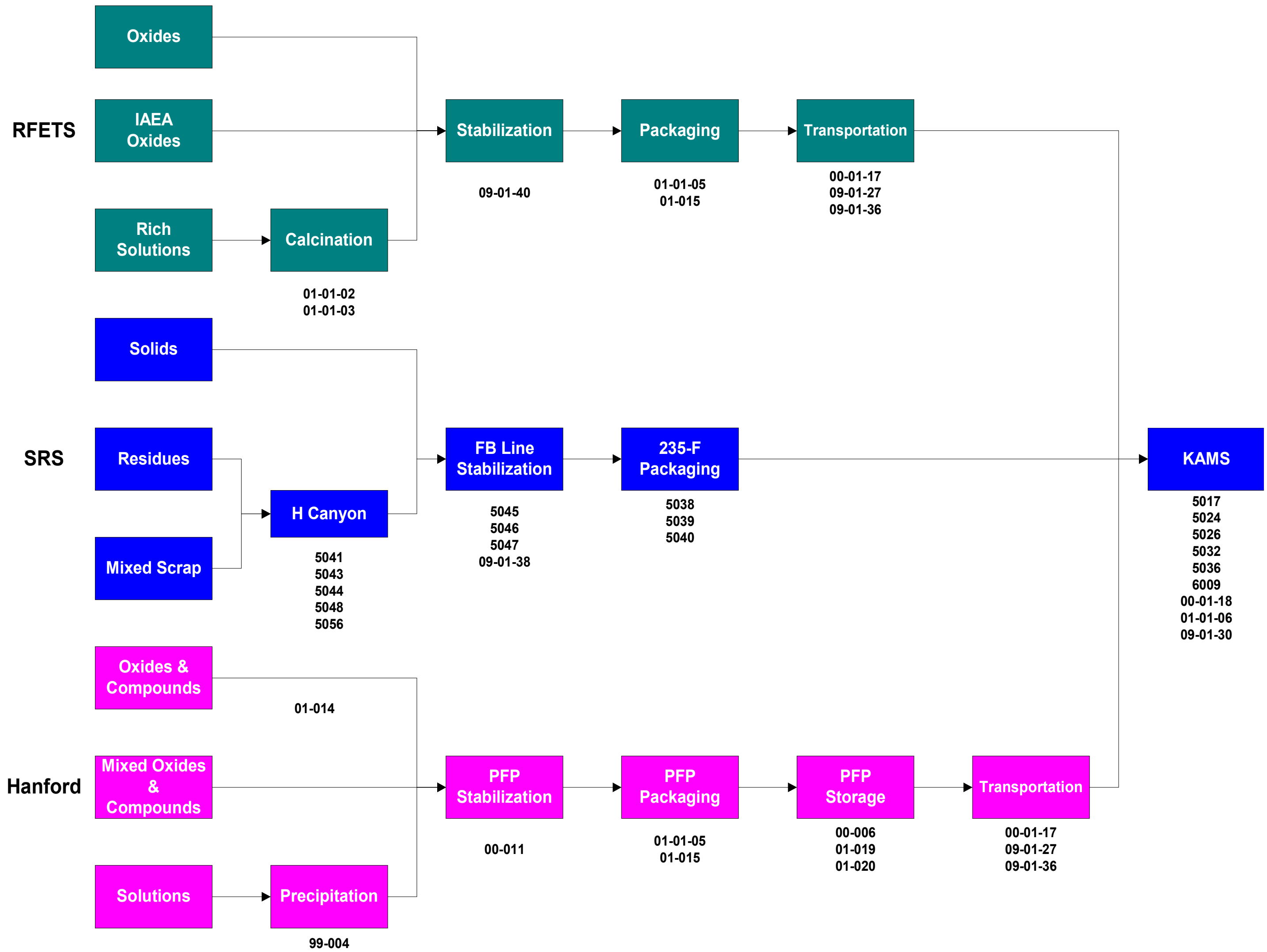


Fig. 1.3, Nuclear Material Roll-up Disposition Map with the associated NMFA Needs

## CONCLUSION

The final step in the NMFA Roadmapping process will be to consolidate the individual site roadmaps into a complex-wide programmatic plan. This will allow the focus area to leverage the strength of needs that address multiple site issues and will help justify the prioritization of work scope into those areas with the most benefit. By incorporating the nuclear material stream disposition pathway data into the Roadmapping process, the NMFA has developed a systematic approach to build a defensible research and development program to address the prominent nuclear material technology needs across the DOE complex.

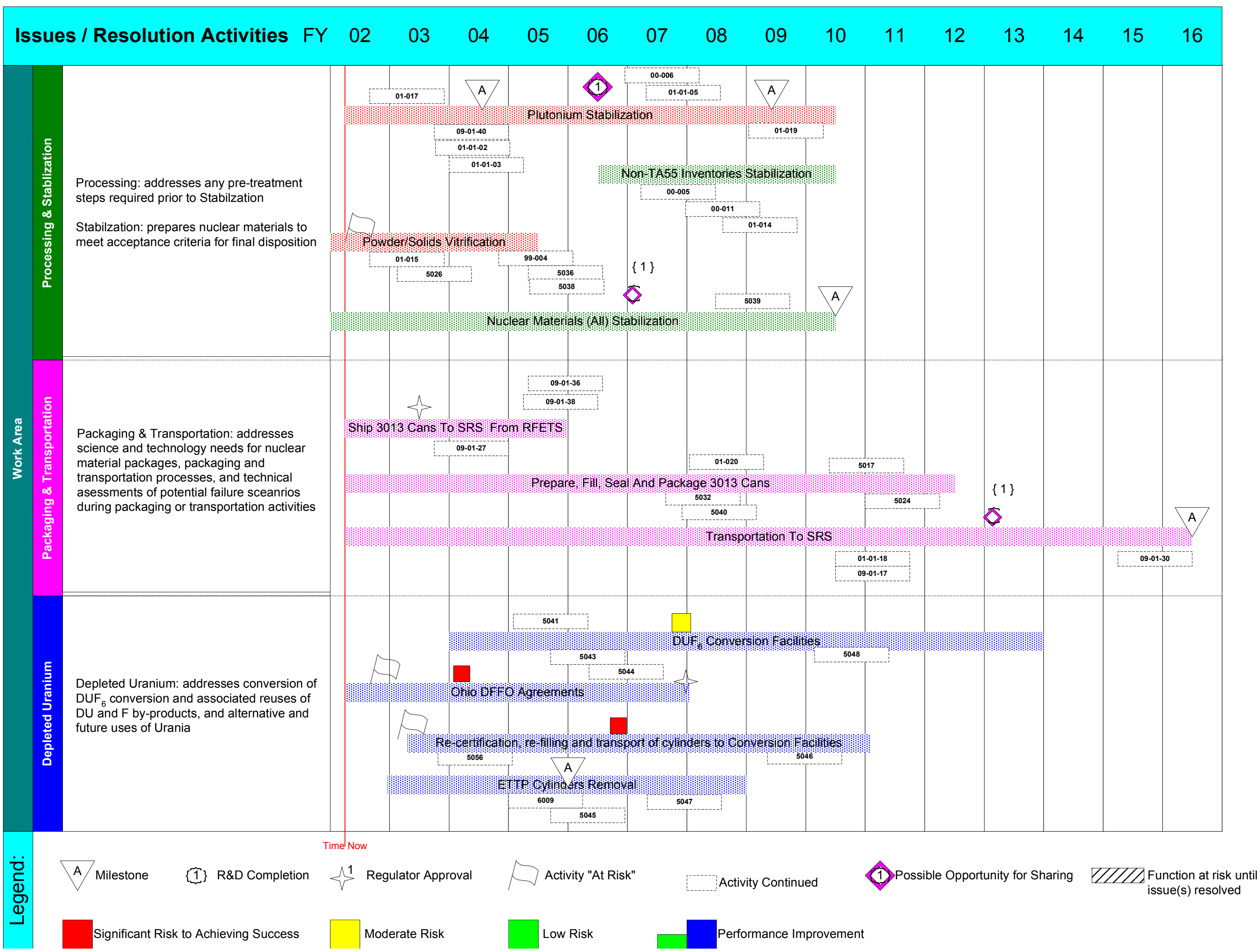


Fig. 1.4, Integrated NMFA Roadmap