

KOPIO WBS Dictionary

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1.2.10

| WBS Number | Description |
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| 1.2.10 | KOPIO Project Detector Systems <p>The KOPIO Detector, large in size and scope, offers as a project many technical challenges in subsystem design, fabrication, installation, testing and commissioning. The overall detector design, utility requirements, installation, testing and commissioning efforts requires managerial control and oversight to assist individual subsystems in their construction efforts.</p> <p>These efforts also include KOPIO Project interface and interaction with the Collider-Accelerator (C-A) project personnel to insure that beam transport and detector meet the physics operational goals as specified in the baseline. The elements of this subsystem establish the KOPIO project management controls for detector integration, installation, conventional systems, testing and commissioning. It includes the cost and schedule of all materials and labor required to accomplish this effort.</p> |
| 1.2.10.1 | Integration <p>Detector integration consists of the following elements: Subsystem dimension control, Detector subsystem utilities routing, Assembly and service scenario modeling, Integration management activities.</p> |
| 1.2.10.1.1 | Subsystem Dimensional Control <p>Engineering and design effort is being devoted to ensure that subsystems fit together, can be assembled and serviced, and have minimal negative impact on other subsystems performance. Subsystem overall integration dimensional boundaries will be defined along with assembly clearances. It is important to note that these integration dimensional boundaries represent simple geometrical volumes and maximum subsystem dimensional limits. Subsystems nominal dimensions will likely be different due to manufacturing and alignment tolerances and will fall within these integration volumes. More detailed geometries will be defined as subsystems evolve. CAD solid modeling will be used to defined these geometries in an unambiguous manner.</p> |
| 1.2.10.1.1.1 | Conceptual Layout |
| 1.2.10.1.1.2 | Conceptual Design Review |
| 1.2.10.1.1.3 | Design |
| 1.2.10.1.2 | Subsystem Utilities Routing |

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| Number | Description |
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| 1.2.10.1.2.1 | Conceptual Layout |
| 1.2.10.1.2.2 | Conceptual Design Review |
| 1.2.10.1.2.3 | Design |
| 1.2.10.1.3 | Assembly & Services Modeling |
| | <p>Initial assembly and subsequent servicing of the detector will be modeled in both 2-D and 3-D CAD in order to determine the dimensions for the experimental area and detector floor pit to insure adequate fit and access on the existing C-A experimental floor. The KOPIO Detector will be assembled, fully connected to utilities, and tested on the experimental floor. The figure below shows the assembled detector in the neutral beam line after the primary beam “B” target station. Once the Switchyard, Primary beam, and Neutral beam line construction is completed along with the experimental floor pit, assembly of the various detector subsystem components can begin based on an approved installation plan. Integration will assist in providing the necessary effort to determine the optimum detector assembly scenario based on beam line construction, subsystem component delivery and staging, and experimental floor space constraints. Integration will also assist in developing detector subsystem component service scenarios. The type of service depends on the component failure, loss of physics coverage, scope of effort and time to repair. A major service scenario may require the detector to be down for more than a day with removal of shielding and the removal and replacement of subsystem components with operable spares. This will require procedures detailing the sequential rigging or removal of adjoining components to access defective components. A minor service scenario would be for quick access, less than a shift, to trouble shoot operational problems or component failures and respond to Detector Safety Interlock alarms. The majority of these minor services issues would be for replacement of electronics components or crate failures. The third type of service would take place during long term C-A shutdowns, monthly time periods, in which many of the subsystems could be disassembled for maintenance and systems upgrades.</p> |
| 1.2.10.1.3.1 | Conceptual Layout |
| 1.2.10.1.3.2 | Conceptual Design Review |
| 1.2.10.1.3.3 | Design |

| WBS | Description |
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| Number | Description |
| 1.2.10.1.4 | Management Activities This element includes the cost for the overall coordination and management of the day-to-day and long term integration activities. Included is the cost of an onsite integration manager, engineering, design drafting, administrative/clerical support, and materials/supplies. |
| 1.2.10.1.4.1 | Pre-construction Effort |
| 1.2.10.1.4.2 | Manager |
| 1.2.10.1.4.3 | Engineering |
| 1.2.10.1.4.4 | Administration |
| 1.2.10.1.4.5 | Procurement |
| 1.2.10.1.4.5.1 | MSTS FY06 |
| 1.2.10.1.4.5.2 | MSTS FY07 |
| 1.2.10.1.4.5.3 | MSTS FY08 |
| 1.2.10.1.4.5.4 | MSTS FY09 |
| 1.2.10.1.4.5.5 | MSTS FY10 |
| 1.2.10.1.4.5.6 | Computer Hardware/Software FY06 |
| 1.2.10.1.4.5.7 | Computer Hardware/Software FY07 |
| 1.2.10.1.4.5.8 | Computer Hardware/Software FY08 |
| 1.2.10.1.4.5.9 | Computer Hardware/Software FY09 |
| 1.2.10.1.4.5.10 | Computer Hardware/Software FY10 |
| 1.2.10.2 | Detector Installation This includes the cost and schedule of all labor required to install the baseline KOPIO Detector in the Collider-Accelerator (C-A) experimental floor, Bldg. 912. Installation consists of the following elements: Subsystem Installation, Installation Equipment, Management Activities |

| WBS | Description |
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| Number | |
| 1.2.10.2.1 | Subsystem Installation |
| | <p>Once a subsystem component of the KOPIO Detector is delivered to the C-A experimental floor at BNL, the expense of further assembly and installation is budgeted for in this element unless otherwise negotiated with the Project Manager. This element includes all labor costs associated with the assembly and installation of all detector subsystems once they have been delivered to the C-A experimental facilities at BNL. This also includes any miscellaneous expense and travel items incurred during these activities. Cost for continuation of engineering and technical support of a detector subsystem by the home institution is not covered by this element. This element does not include the cost of planning the installation of individual detector subsystems. This means planning for installation of individual subsystems is included in subsystem WBS and overall installation planning is included in Integration. Subsystem installation includes the following subsystems:</p> |
| 1.2.10.2.1.1 | Vacuum |
| 1.2.10.2.1.1.1 | Start U/S Decay Vessel Assembly |
| 1.2.10.2.1.1.2 | Deliver U/S Decay Vessel |
| 1.2.10.2.1.1.3 | Uncrate and Stage |
| 1.2.10.2.1.1.4 | Install Internal CPV Supports |
| 1.2.10.2.1.1.5 | Clean and Pre-Assemble |
| 1.2.10.2.1.1.6 | Install Feed-throughs in Adapter Flanges |
| 1.2.10.2.1.1.7 | Vessel Pressure Testing |
| 1.2.10.2.1.1.8 | Disassemble Vessel |
| 1.2.10.2.1.1.9 | Install U/S Vacuum Pipe and End Dome |
| 1.2.10.2.1.1.10 | Install Vessel Supports in Photon Veto |
| 1.2.10.2.1.1.11 | Install Cylindrical Vessel in Photon Veto |
| 1.2.10.2.1.1.12 | Install D/S Vacuum Pipe and End Dome |
| 1.2.10.2.1.1.13 | Install Internal CPV Modules |

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| Number | Description |
| 1.2.10.2.1.1.14 | Install HV Membrane and Windows |
| 1.2.10.2.1.1.15 | Close U/S Decay Vessel |
| 1.2.10.2.1.1.16 | Rout Fiber and Cable |
| 1.2.10.2.1.1.17 | U/S Decay Vessel Assembly Complete |
| 1.2.10.2.1.1.18 | Start D/S Vessel Assembly |
| 1.2.10.2.1.1.19 | Deliver Support Structure |
| 1.2.10.2.1.1.20 | Establish Reference Datums |
| 1.2.10.2.1.1.21 | Install Floor Anchors |
| 1.2.10.2.1.1.22 | Install Floor Plates |
| 1.2.10.2.1.1.23 | Level Floor Plates |
| 1.2.10.2.1.1.24 | Install Grout Frames |
| 1.2.10.2.1.1.25 | Grout Floor Plates |
| 1.2.10.2.1.1.26 | Deliver D/S Vessel |
| 1.2.10.2.1.1.27 | Uncrate and Stage |
| 1.2.10.2.1.1.28 | Install Veto Detector Supports |
| 1.2.10.2.1.1.29 | Clean and Assemble |
| 1.2.10.2.1.1.30 | Install Feed-throughs and Flanges |
| 1.2.10.2.1.1.31 | Vessel Pressure Testing |
| 1.2.10.2.1.1.32 | Rout Fiber and Cable |
| 1.2.10.2.1.1.33 | D/S Vessel Assembly Complete |
| 1.2.10.2.1.1.34 | Start Vacuum Pumping Station Assembly |

| WBS | |
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| Number | Description |
| 1.2.10.2.1.1.35 | Deliver Pumping Skid |
| 1.2.10.2.1.1.36 | Pour Concrete Pad |
| 1.2.10.2.1.1.37 | Install Floor Anchors |
| 1.2.10.2.1.1.38 | Install Skid on Pad |
| 1.2.10.2.1.1.39 | Hook-up AC Power |
| 1.2.10.2.1.1.40 | Connect Vacuum System |
| 1.2.10.2.1.1.41 | System Testing |
| 1.2.10.2.1.1.42 | Vacuum Pump Station Assembly Complete |
| 1.2.10.2.1.2 | Preradiator |
| 1.2.10.2.1.2.1 | Start Mechanical Assembly |
| 1.2.10.2.1.2.2 | Deliver Support Structure |
| 1.2.10.2.1.2.3 | Establish Reference Datums |
| 1.2.10.2.1.2.4 | Install Floor Anchors |
| 1.2.10.2.1.2.5 | Install Floor Plates |
| 1.2.10.2.1.2.6 | Level Floor Plates |
| 1.2.10.2.1.2.7 | Install Grout Frames |
| 1.2.10.2.1.2.8 | Grout Floor Plates |
| 1.2.10.2.1.2.9 | Assemble Support Structure |
| 1.2.10.2.1.2.10 | Deliver Module Support Fixtures |
| 1.2.10.2.1.2.11 | Assemble Module Support Fixtures |
| 1.2.10.2.1.2.12 | Deliver Modules |

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| WBS | |
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| Number | Description |
| 1.2.10.2.1.2.13 | Stage Modules on Fixtures |
| 1.2.10.2.1.2.14 | Pre-Testing of Modules |
| 1.2.10.2.1.2.15 | Install Modules in Support Structure |
| 1.2.10.2.1.2.16 | Deliver Gas System |
| 1.2.10.2.1.2.17 | Install Gas System |
| 1.2.10.2.1.2.18 | Deliver Chilled Water System |
| 1.2.10.2.1.2.19 | Install Chilled Water System |
| 1.2.10.2.1.2.20 | Install Hydraulic Drives |
| 1.2.10.2.1.2.21 | Roll Into Operating Position |
| 1.2.10.2.1.2.22 | Mechanical Assembly Complete |
| 1.2.10.2.1.2.23 | Start Electrical Assembly |
| 1.2.10.2.1.2.24 | Deliver Crates and Cables |
| 1.2.10.2.1.2.25 | Install Crates in Racks |
| 1.2.10.2.1.2.26 | Install Subsystem Cable Tray |
| 1.2.10.2.1.2.27 | Install Cable Bundles |
| 1.2.10.2.1.2.28 | Subsystem Testing |
| 1.2.10.2.1.2.28.1 | Engineering |
| 1.2.10.2.1.2.28.2 | Technical |
| 1.2.10.2.1.2.29 | Electrical Assembly Complete |
| 1.2.10.2.1.3 | Calorimeter |
| 1.2.10.2.1.3.1 | Start Mechanical Assembly |

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| Number | Description |
| 1.2.10.2.1.3.2 | Deliver Support Structure |
| 1.2.10.2.1.3.3 | Establish Reference Datums |
| 1.2.10.2.1.3.4 | Install Floor Anchors |
| 1.2.10.2.1.3.5 | Install Floor Plates |
| 1.2.10.2.1.3.6 | Level Floor Plates |
| 1.2.10.2.1.3.7 | Install Grout Frames |
| 1.2.10.2.1.3.8 | Grout Floor Plates |
| 1.2.10.2.1.3.9 | Assemble Support Structure |
| 1.2.10.2.1.3.10 | Deliver Shashlyk Modules |
| 1.2.10.2.1.3.11 | Install Lower Half Modules |
| 1.2.10.2.1.3.12 | Install D/S Vacuum Pipe and End Dome |
| 1.2.10.2.1.3.13 | Install Upper Half Modules |
| 1.2.10.2.1.3.14 | Install Hydraulic Drives |
| 1.2.10.2.1.3.15 | Roll Into Operating Position |
| 1.2.10.2.1.3.16 | Mechanical Assembly Complete |
| 1.2.10.2.1.3.17 | Start Electrical Assembly |
| 1.2.10.2.1.3.18 | Deliver Crates and Cables |
| 1.2.10.2.1.3.19 | Install Crates in Racks |
| 1.2.10.2.1.3.20 | Install Subsystem Cable Tray |
| 1.2.10.2.1.3.21 | Install Cable Bundles |
| 1.2.10.2.1.3.22 | Subsystem Testing |

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| Number | Description |
| 1.2.10.2.1.3.22.1 | Engineering |
| 1.2.10.2.1.3.22.2 | Technical |
| 1.2.10.2.1.3.23 | Electrical Assembly Complete |
| 1.2.10.2.1.4 | Charged Particle Veto |
| 1.2.10.2.1.4.1 | Deliver CPV Supports |
| 1.2.10.2.1.4.2 | Install Internal CPV Supports |
| 1.2.10.2.1.4.3 | Deliver CPV Modules |
| 1.2.10.2.1.4.4 | Install CPV Modules in Vessel |
| 1.2.10.2.1.4.5 | Fiber and Cable Connections |
| 1.2.10.2.1.4.6 | Close U/S Decay Vessel |
| 1.2.10.2.1.4.7 | System testing |
| 1.2.10.2.1.4.8 | CPV Installed |
| 1.2.10.2.1.5 | Photon Veto |
| 1.2.10.2.1.5.1 | Start Mechanical Assembly |
| 1.2.10.2.1.5.2 | Deliver Support Structure |
| 1.2.10.2.1.5.3 | Establish Reference Datums |
| 1.2.10.2.1.5.4 | Install Floor Anchors |
| 1.2.10.2.1.5.5 | Install Floor Plates |
| 1.2.10.2.1.5.6 | Level Floor Plates |
| 1.2.10.2.1.5.7 | Install Grout Frames |
| 1.2.10.2.1.5.8 | Grout Floor Plates |

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| Number | Description |
| 1.2.10.2.1.5.9 | Install U/S Wall Support Structure |
| 1.2.10.2.1.5.10 | Deliver U/S Wall Modules |
| 1.2.10.2.1.5.11 | Install Lower Half U/S Wall Modules |
| 1.2.10.2.1.5.12 | Install U/S Vacuum Pipe and End Dome |
| 1.2.10.2.1.5.13 | Install Upper Half U/S Wall Modules |
| 1.2.10.2.1.5.14 | Install Cylindrical Support Structure |
| 1.2.10.2.1.5.15 | Deliver Cylindrical Modules |
| 1.2.10.2.1.5.16 | Install Lower Half Cylindrical Modules |
| 1.2.10.2.1.5.17 | Install Vacuum Decay Tank Supports |
| 1.2.10.2.1.5.18 | Install Upper Half Cylindrical Modules |
| 1.2.10.2.1.5.19 | Mechanical Ass'y. Complete |
| 1.2.10.2.1.5.20 | Start Electrical Assembly |
| 1.2.10.2.1.5.21 | Deliver Crates and Cables |
| 1.2.10.2.1.5.22 | Install Crates in Racks |
| 1.2.10.2.1.5.23 | Install Subsystem Cable Tray |
| 1.2.10.2.1.5.24 | Install Cable Bundles |
| 1.2.10.2.1.5.25 | Subsystem Testing |
| 1.2.10.2.1.5.25.1 | Engineering |
| 1.2.10.2.1.5.25.2 | Technical |
| 1.2.10.2.1.5.26 | Electrical Assembly Complete |
| 1.2.10.2.1.6 | Catcher |

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| Number | Description |
| 1.2.10.2.1.6.1 | Start Catcher Assembly |
| 1.2.10.2.1.6.2 | Deliver Support Structure |
| 1.2.10.2.1.6.3 | Establish Reference Datums |
| 1.2.10.2.1.6.4 | Install Floor Anchors |
| 1.2.10.2.1.6.5 | Install Floor Plates |
| 1.2.10.2.1.6.6 | Level Floor Plates |
| 1.2.10.2.1.6.7 | Install Grout Frames |
| 1.2.10.2.1.6.8 | Grout Floor Plates |
| 1.2.10.2.1.6.9 | Install Support Structure |
| 1.2.10.2.1.6.10 | Install Detector Modules |
| 1.2.10.2.1.6.11 | Deliver Crates and Cables |
| 1.2.10.2.1.6.12 | Install Crates in Racks |
| 1.2.10.2.1.6.13 | Install Cable Bundles |
| 1.2.10.2.1.6.14 | Subsystem Testing |
| 1.2.10.2.1.6.14.1 | Engineering |
| 1.2.10.2.1.6.14.2 | Technical |
| 1.2.10.2.1.6.15 | Catcher Assembly Complete |
| 1.2.10.2.1.7 | Conventional Systems |
| 1.2.10.2.1.7.1 | Mechanical Utilities |
| 1.2.10.2.1.7.1.1 | Chilled Water Systems |
| 1.2.10.2.1.7.1.1.1 | Staging |

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| Number | Description |
| 1.2.10.2.1.7.1.1.2 | Installation & Distribution |
| 1.2.10.2.1.7.1.1.3 | Piping |
| 1.2.10.2.1.7.1.1.4 | Electrical |
| 1.2.10.2.1.7.1.2 | Conditioned Air Systems |
| 1.2.10.2.1.7.1.2.1 | Staging |
| 1.2.10.2.1.7.1.2.2 | Install Enclosure |
| 1.2.10.2.1.7.1.2.3 | Ducting & Piping |
| 1.2.10.2.1.7.1.2.4 | Electrical |
| 1.2.10.2.1.7.1.3 | Compressed Air Systems |
| 1.2.10.2.1.7.1.3.1 | Staging |
| 1.2.10.2.1.7.1.3.2 | Installation |
| 1.2.10.2.1.7.1.3.3 | Electrical |
| 1.2.10.2.1.7.2 | Electrical Utilities |
| 1.2.10.2.1.7.2.1 | Commercial Power Distribution |
| 1.2.10.2.1.7.2.1.1 | Staging |
| 1.2.10.2.1.7.2.1.2 | Installation |
| 1.2.10.2.1.7.2.2 | Clean Power Distribution |
| 1.2.10.2.1.7.2.2.1 | Staging |
| 1.2.10.2.1.7.2.2.2 | Installation |
| 1.2.10.2.1.7.2.3 | UPS Distribution |
| 1.2.10.2.1.7.2.3.1 | Staging |

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| Number | Description |
| 1.2.10.2.1.7.2.3.2 | Electrical Installation |
| 1.2.10.2.1.7.2.4 | Emergency Power Distribution |
| 1.2.10.2.1.7.2.4.1 | Installation |
| 1.2.10.2.1.7.2.5 | Grounding |
| 1.2.10.2.1.7.2.5.1 | Mechanical Installation |
| 1.2.10.2.1.7.2.5.2 | Electrical Installation |
| 1.2.10.2.1.7.2.6 | Cable Distribution Systems |
| 1.2.10.2.1.7.2.6.1 | Staging |
| 1.2.10.2.1.7.2.6.2 | Tray Installation |
| 1.2.10.2.1.7.2.6.3 | Electrical Installation |
| 1.2.10.2.1.7.2.6.4 | Power Connection |
| 1.2.10.2.1.7.3 | Safety Systems |
| 1.2.10.2.1.7.3.1 | Global Interlocks and Alarm Systems |
| 1.2.10.2.1.7.3.1.1 | Mechanical Installation |
| 1.2.10.2.1.7.3.1.2 | Electrical Installation |
| 1.2.10.2.1.7.3.1.3 | Programming |
| 1.2.10.2.1.7.3.2 | Water Leak Detection Systems |
| 1.2.10.2.1.7.3.2.1 | Mechanical Installation |
| 1.2.10.2.1.7.3.2.2 | Electrical Installation |
| 1.2.10.2.1.7.3.3 | Smoke and Heat Detection Systems |
| 1.2.10.2.1.7.3.3.1 | Electrical Installation |

| WBS | Description |
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| Number | Description |
| 1.2.10.2.1.7.3.4 | Flammable Gas Detection Systems |
| 1.2.10.2.1.7.3.4.1 | Mechanical Installation |
| 1.2.10.2.1.7.3.4.2 | Electrical Installation |
| 1.2.10.2.1.7.3.5 | Emergency Shutdown Systems |
| 1.2.10.2.1.7.3.5.2 | Electrical Installation |
| 1.2.10.2.1.7.3.6 | Fire Suppression Systems |
| 1.2.10.2.1.7.3.6.1 | Mechanical Installation |
| 1.2.10.2.1.7.3.6.2 | Electrical Installation |
| 1.2.10.2.1.7.3.7 | ODH Detection Systems |
| 1.2.10.2.1.7.3.7.1 | Mechanical Installation |
| 1.2.10.2.1.7.3.7.2 | Electrical Installation |
| 1.2.10.2.1.7.4 | Personnel Access Systems |
| 1.2.10.2.1.7.4.1 | Scaffolding Systems |
| 1.2.10.2.1.7.4.1.1 | Erect Scaffolding |
| 1.2.10.2.1.7.4.2 | Stairs and Walkways |
| 1.2.10.2.1.7.4.2.1 | Mechanical Installation |
| 1.2.10.2.2 | Installation Equipment |
| | This element includes the cost of specifying, designing, fabricating, procuring, or leasing commonly used equipment associated with installation of the KOPIO Detector. This includes hardware such as man-lifts, fork-lifts, spreader bars, standard rigging gear, hand tools, standard electronics equipment (meters, o-scopes), vehicles, and storage trailers. This does not include the cost of special installation fixtures or test equipment associated with an individual detector subsystem. |
| 1.2.10.2.2.1 | Conceptual Planning |

| WBS | Description |
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| Number | Description |
| 1.2.10.2.2.2 | Conceptual Design Review |
| 1.2.10.2.2.3 | Procurement |
| 1.2.10.2.2.3.1 | Equipment Rental FY07 |
| 1.2.10.2.2.3.2 | Equipment Rental FY08 |
| 1.2.10.2.2.3.3 | Equipment Rental FY09 |
| 1.2.10.2.2.3.4 | Equipment Rental FY10 |
| 1.2.10.2.2.3.5 | MSTS FY06 |
| 1.2.10.2.2.3.6 | MSTS FY07 |
| 1.2.10.2.2.3.7 | MSTS FY08 |
| 1.2.10.2.2.3.8 | MSTS FY09 |
| 1.2.10.2.2.3.9 | MSTS FY10 |
| 1.2.10.2.2.3.10 | Misc. Fabrication FY06 |
| 1.2.10.2.2.3.11 | Misc. Fabrication FY07 |
| 1.2.10.2.2.3.12 | Misc. Fabrication FY08 |
| 1.2.10.2.2.3.13 | Misc. Fabrication FY09 |
| 1.2.10.2.2.3.14 | Misc. Fabrication FY10 |
| 1.2.10.2.3 | Management Activities |
| | This element includes the cost for the overall coordination and management of the day-to-day and long term installation activities. Included is the cost of an onsite installation manager, technical supervisor, design drafting, and clerical support. |
| 1.2.10.2.3.1 | Pre-construction Effort |
| 1.2.10.2.3.2 | Manager |

| WBS | Description |
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| Number | Description |
| 1.2.10.2.3.3 | Engineering |
| 1.2.10.2.3.4 | Technical Supervisor |
| 1.2.10.2.3.5 | Administration |
| 1.2.10.2.3.6 | Procurement |
| 1.2.10.2.3.6.1 | MSTS FY06 |
| 1.2.10.2.3.6.2 | MSTS FY07 |
| 1.2.10.2.3.6.3 | MSTS FY08 |
| 1.2.10.2.3.6.4 | MSTS FY09 |
| 1.2.10.2.3.6.5 | MSTS FY10 |
| 1.2.10.2.3.6.6 | Computer Hardware/Software FY06 |
| 1.2.10.2.3.6.7 | Computer Hardware/Software FY07 |
| 1.2.10.2.3.6.8 | Computer Hardware/Software FY08 |
| 1.2.10.2.3.6.9 | Computer Hardware/Software FY09 |
| 1.2.10.2.3.6.10 | Computer Hardware/Software FY10 |
| 1.2.10.3 | Conventional Systems |

The scope of this element accounts for all utility requirements for the KOPIO Detector that are common to more than one subsystem. Conventional systems requirements are derived from the specific subsystem's needs and general detector integration requirements. The source of these utilities comes from the C-A department, which is only responsible for bring general AC power, cooling water, and compressed air to common interface taps near the detector. This element does not include the shielding, detector pit, conventional structures (fast electronics house, control room, counting house, gas pad, gas mixing room), facility lighting, facility fire detection and suppression, and facility overhead crane which are C-A's responsibilities. This includes the cost and schedule of all labor required for design and procurement of materials. Conventional systems consist of the following elements: Mechanical utilities, Electrical utilities, Safety systems, Personnel access systems, Management activities.

| WBS | Description |
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| Number | |
| 1.2.10.3.1 | <p>Mechanical Utilities</p> <p>These utilities systems consist of the following elements:Chilled water system- this system provides cooling water to maintain operational temperature specification of subsystem electronics. The scope of effort will be to determine and specify common electronics cooling requirements and provide the necessary closed loop chilled water pumping skid in a heat exchange with C-A SCM water systems. To distribute this cooling water as required to the various detector subsystems such as electronics racks, calorimeter PMT's and APD's, and on-board electronics crates. This will include the cost for specification, design, procurement, fabrication, and delivery of all system hardware, piping distribution and controls. Conditioned air system and enclosure- air circulation in and around the detector is not designed to remove any heat load, but to maintain a uniform temperature and low humidity condition. With the majority of the detector heat load removed by chilled water it is necessary to maintain a low enough ambient air dew point to prevent condensation from forming in and around electronics components and detector surfaces. This will include the cost for specification, design, procurement, fabrication, and delivery of all system hardware, ducting distribution, controls, and enclosure.Compressed air systems- if required for experimental use for pneumatic controls, flammable gas detectors, or the use of vortec instrument coolers. This would include the cost for specification, design, procurement, fabrication, and delivery of all system hardware such as compressor, air dryer, filtration, controls and distribution.</p> |
| 1.2.10.3.1.1 | Chilled Water Systems |
| 1.2.10.3.1.1.1 | Concept Specification |
| 1.2.10.3.1.1.2 | Conceptual Design Review |
| 1.2.10.3.1.1.3 | Engineering |
| 1.2.10.3.1.1.4 | Design |
| 1.2.10.3.1.1.5 | Procurement |
| 1.2.10.3.1.1.6 | Fabrication |
| 1.2.10.3.1.2 | Conditioned Air Systems & Enclosure |
| 1.2.10.3.1.2.1 | Concept Specification |
| 1.2.10.3.1.2.2 | Conceptual Design Review |
| 1.2.10.3.1.2.3 | Engineering |
| 1.2.10.3.1.2.4 | Design |

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| WBS | |
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| Number | Description |
| 1.2.10.3.1.2.5 | Procurement |
| 1.2.10.3.1.2.6 | Fabrication |
| 1.2.10.3.1.3 | Compressed Air Systems |
| 1.2.10.3.1.3.1 | Concept Specification |
| 1.2.10.3.1.3.2 | Conceptual Design Review |
| 1.2.10.3.1.3.3 | Engineering |
| 1.2.10.3.1.3.4 | Design |
| 1.2.10.3.1.3.5 | Procurement |
| 1.2.10.3.1.3.6 | Fabrication |
| 1.2.10.3.2 | Electrical Utilities |

WBS

1.2.10

Number

Description

These utility systems consist of the following elements: Commercial power distribution- this is the continuation and distribution of C-A facility power (dirty power) through the experimental area as required. It represents the nominal 110/208/480-vac power required to power mechanical and rotary equipment and tools used in the installation, maintenance, and operation of the detector. This would include the cost for specification, design, procurement, and delivery of all system hardware such as breaker panels, conduit, cable and receptacles. Clean power distribution- this is experimental power derived from commercial power through isolation transformers on a common single point detector electrical ground. This is done so that machinery or other rotary equipment used upstream of the isolation transformer, does not induce electrical noise into detector electronics. The majority of this power will be used to power experimental subsystem electronics, electrical crates, LV/HV power supplies, electrical racks and control room computer systems all on a common ground. This would include the cost for specification, design, procurement, and delivery of all system hardware such as isolation transformers, breaker panels, conduit, cable and receptacles. Uninterrupted power systems- this power is derived from clean power and provides temporary back-up for critical operational experimental systems. These are usually rack mountable battery systems (UPS) that provide 20-30 minute power during commercial power dips. They will be required for critical systems that monitor safety interlocks and detectors, flammable gas systems controls, and control room computers. This would include the cost of specification, procurement, and delivery of all system hardware. Emergency power distribution- this power is derived from diesel generator back-up systems at C-A. It will be needed for experimental emergency lighting, cooling systems for temperature critical components, flammable gas systems, and critical vacuum systems. This would include the cost of specification, procurement, and delivery of all system hardware for distribution at the experiment. Detector electrical grounding- because there are many low voltage and low current signals used in the detector subsystems, it is necessary to insure that we operate in a low electrical noise environment. Consequently, proper precautions must be taken when planning the grounding of the detector in conjunction with clean electrical power distribution and ground fault monitoring, to eliminate ground loops and reduce electrical noise. This would include the cost of specification, design, procurement, and delivery of all system hardware for the experiment. Electronics rack systems- these racks are used to house the majority of experimental electronics instrumentation, crates and power supplies needed in support of detector subsystems. The majority of these racks will be housed either in the Fast Electronics House or the control room and will sit atop elevated computer flooring to allow for orderly distribution of cable bundles to and from the racks. These are 19-inch standard rack widths, which will contain AC clean power distribution and breaker panels, smoke and heat detection, chilled water distribution and heat exchangers, fan blowers and filter units. This would include the cost of specification, design, procurement, and delivery of all system hardware for the experiment. Cable distribution systems- this is a system of wire ways, cable trays, conduits, and festoon systems required to distribute AC power, LV/HV power, signal, and fiber optic cable bundles throughout the detector, its subsystems, Fast Electronics House and control room. Specially configured cable trolleys and flexible tray systems maybe required to maintain electrical interconnectivity while subsystem components are maneuvered for maintenance and access needs. This would include the cost of specification, design, procurement, and delivery of all system hardware for the experiment.

| WBS | |
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| Number | Description |
| 1.2.10.3.2.1 | Commercial Power Distribution |
| 1.2.10.3.2.1.1 | Concept Specification |
| 1.2.10.3.2.1.2 | Conceptual Design Review |
| 1.2.10.3.2.1.3 | Engineering |
| 1.2.10.3.2.1.4 | Design |
| 1.2.10.3.2.1.5 | Procurement |
| 1.2.10.3.2.2 | Clean Power Distribution |
| 1.2.10.3.2.2.1 | Concept Specification |
| 1.2.10.3.2.2.2 | Conceptual Design Review |
| 1.2.10.3.2.2.3 | Engineering |
| 1.2.10.3.2.2.4 | Design |
| 1.2.10.3.2.2.5 | Procurement |
| 1.2.10.3.2.3 | Uninterrupted Power Systems |
| 1.2.10.3.2.3.1 | Concept Specification |
| 1.2.10.3.2.3.2 | Conceptual Design Review |
| 1.2.10.3.2.3.3 | Engineering |
| 1.2.10.3.2.3.4 | Design |
| 1.2.10.3.2.3.5 | Procurement |
| 1.2.10.3.2.4 | Emergency Power Distribution |
| 1.2.10.3.2.4.1 | Concept Specification |
| 1.2.10.3.2.4.2 | Conceptual Design Review |

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| WBS Number | Description |
|-----------------------|----------------------------|
| 1.2.10.3.2.4.3 | Engineering |
| 1.2.10.3.2.4.4 | Design |
| 1.2.10.3.2.4.5 | Procurement |
| 1.2.10.3.2.5 | Detector Electrical Ground |
| 1.2.10.3.2.5.1 | Concept Specification |
| 1.2.10.3.2.5.2 | Conceptual Design Review |
| 1.2.10.3.2.5.3 | Engineering |
| 1.2.10.3.2.5.4 | Design |
| 1.2.10.3.2.5.5 | Procurement |
| 1.2.10.3.2.5.6 | Fabrication |
| 1.2.10.3.2.6 | Electronics Rack Systems |
| 1.2.10.3.2.6.1 | Concept Specification |
| 1.2.10.3.2.6.2 | Conceptual Design Review |
| 1.2.10.3.2.6.3 | Engineering |
| 1.2.10.3.2.6.4 | Design |
| 1.2.10.3.2.6.5 | Procurement |
| 1.2.10.3.2.6.6 | Fabrication |
| 1.2.10.3.2.7 | Cable Distribution Systems |
| 1.2.10.3.2.7.1 | Concept Specification |
| 1.2.10.3.2.7.2 | Conceptual Design Review |
| 1.2.10.3.2.7.3 | Engineering |

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| WBS Number | Description |
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| 1.2.10.3.2.7.4 | Design |
| 1.2.10.3.2.7.5 | Procurement |
| 1.2.10.3.2.7.6 | Fabrication |
| 1.2.10.3.3 | Safety Systems |

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Number

Description

These utilities systems consist of the following elements: Global interlocks and alarm systems- this is a system designed to allow the KOPIO detector and its subsystems to operate safely; it provides protection against major equipment damage, particularly that due to the effects of fire and water leakage. Typically, each subsystem will have its own local interlock system that will detect and react to hazards localized to the particular component (over current or over temperature, for example). These local interlock systems are used to guide the power-up and power-down procedures, and are not within the scope of this element. The global interlocks and alarm system is mainly concerned with major hazards from common utilities (conventional systems) failures, and contains interlock and alarm elements for water leak detection, smoke and heat detection, flammable gas detection, and emergency off system. The system must satisfy the requirements of the detector electrical grounding plan. This system will be implemented using industry standard programmable logic controllers (PLCs) based on relay logic code. This would include the cost of specification, design, procurement, and delivery of all system hardware for the experiment. System operation, maintenance, and certification will be the responsibility of C-A department. Water leak detection systems- this is a system used to automatically sense water leaks, usually at hose fittings and connections, from the distributed chilled water system throughout the detector and interrupt flow, with automatic valves, to that circuit in order to minimize damage to critical electronics. It would be integrated into the Global interlocks and alarm system and is required for equipment protection. A similar system, within C-A scope, to detect sweeper magnet water leaks may need to be integrated into the same interlocks and alarm system. This would include the cost of specification, design, procurement, and delivery of all system hardware for the experiment. Smoke and heat detection systems- this is a fire detection system of high sensitivity smoke and heat detectors located inside electronics rack bays and in close proximity to operational detector electronics. The system of detectors along with programmable fire alarm panels would fall within the scope of the BNL Fire Systems Group for life safety requirements with direct alarm notification to the BNL fire station. It would also be integrated into the Global interlocks and alarm system for equipment protection. Detection of smoke would latch an interlock and alarm and automatically trip electrical power to subsystems and electronics in the detection area. Heat detection would automatically trip electrical power and engage fire suppression systems if required. This would include the cost of specification, design, procurement, and delivery of all system hardware for the experiment. Flammable gas detection systems- this is a system used to sniff and detect combustible levels of flammable gas leaking from experimental gas distribution systems into the environment. It will require multiplexing from numerous detection sites and calibration capability. It would be integrated into the Global interlocks and alarm system and is required for equipment protection. This would include the cost of specification, design, procurement, and delivery of all system hardware for the experiment. Emergency shutdown systems- this is a system intended for the emergency use of authorized and trained personnel who detect hazardous conditions, for equipment protection, that require immediate action. These will be clearly labeled and manually operated emergency off buttons located at strategic locations in the experimental area; experimental area access gate, fast electronics house, control room, and experimental pit. These emergency off buttons are interlocked to the experiment AC power distribution system and via shunt-trips will force circuit breakers to open, positively removing electrical hazards. The loss of experimental AC power will require all subsystems to fail to a safe state which will require the purge of all flammable gases. This would include the cost of specification, design, procurement, and delivery of all system hardware for the experiment. System maintenance and certification will be the responsibility of C-A department. Fire suppression systems- this is a system that maybe required based on DOE/BNL guidelines of equipment loss value. These are automated systems that are engaged from heat detectors located in

electronics racks. A typical system will flood a rack compartment with an inert gas to reduce oxygen levels and extinguish any fire once the source of power is removed. This fire suppression Page 23 of 30

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system would fall within the scope of the BNL Fire Systems Group for life safety requirements with direct alarm notification to the BNL fire station. This would include the cost of specification, design, procurement, and delivery of all system hardware for the experiment. ODH detection systems- this is an oxygen-deficiency-hazard system of detectors and monitors used in the experimental pit area and experimental gas mixing areas to alert personnel of the hazard. This system would fall within the scope of the C-A Personnel Access and Security Systems (PASS) Group for life safety requirements. This would include the cost of specification, design, procurement, and delivery of all system hardware for the experiment.

- 1.2.10.3.3.1 Global Interlocks and Alarm Systems**
- 1.2.10.3.3.1.1 Concept Specification**
- 1.2.10.3.3.1.2 Conceptual Design Review**
- 1.2.10.3.3.1.3 Engineering**
- 1.2.10.3.3.1.4 Design**
- 1.2.10.3.3.1.5 Procurement**
- 1.2.10.3.3.1.6 Fabrication**
- 1.2.10.3.3.2 Water Leak Detection Systems**
- 1.2.10.3.3.2.1 Concept Specification**
- 1.2.10.3.3.2.2 Conceptual Design Review**
- 1.2.10.3.3.2.3 Engineering**
- 1.2.10.3.3.2.4 Design**
- 1.2.10.3.3.2.5 Procurement**
- 1.2.10.3.3.2.6 Fabrication**
- 1.2.10.3.3.3 Smoke and Heat Detection Systems**

| WBS | |
|----------------|---------------------------------|
| Number | Description |
| 1.2.10.3.3.3.1 | Concept Specification |
| 1.2.10.3.3.3.2 | Conceptual Design Review |
| 1.2.10.3.3.3.3 | Engineering |
| 1.2.10.3.3.3.4 | Design |
| 1.2.10.3.3.3.5 | Procurement |
| 1.2.10.3.3.4 | Flammable Gas Detection Systems |
| 1.2.10.3.3.4.1 | Concept Specification |
| 1.2.10.3.3.4.2 | Conceptual Design Review |
| 1.2.10.3.3.4.3 | Engineering |
| 1.2.10.3.3.4.4 | Design |
| 1.2.10.3.3.4.5 | Procurement |
| 1.2.10.3.3.4.6 | Fabrication |
| 1.2.10.3.3.5 | Emergency Shutdown Systems |
| 1.2.10.3.3.5.1 | Concept Specification |
| 1.2.10.3.3.5.2 | Conceptual Design Review |
| 1.2.10.3.3.5.3 | Engineering |
| 1.2.10.3.3.5.4 | Design |
| 1.2.10.3.3.5.5 | Procurement |
| 1.2.10.3.3.5.6 | Fabrication |
| 1.2.10.3.3.6 | Fire Suppression Systems |
| 1.2.10.3.3.6.1 | Concept Specification |

WBS

| Number | Description |
|----------------|--------------------------|
| 1.2.10.3.3.6.2 | Conceptual Design Review |
| 1.2.10.3.3.6.3 | Engineering |
| 1.2.10.3.3.6.4 | Design |
| 1.2.10.3.3.6.5 | Procurement |
| 1.2.10.3.3.6.6 | Fabrication |
| 1.2.10.3.3.7 | ODH Detection Systems |
| 1.2.10.3.3.7.1 | Concept Specification |
| 1.2.10.3.3.7.2 | Conceptual Design Review |
| 1.2.10.3.3.7.3 | Engineering |
| 1.2.10.3.3.7.4 | Design |
| 1.2.10.3.3.7.5 | Procurement |
| 1.2.10.3.3.7.6 | Fabrication |
| 1.2.10.3.4 | Personnel Access Systems |
| 1.2.10.3.4.1 | Scaffolding Systems |
| 1.2.10.3.4.1.1 | Concept Specification |

These utilities systems consist of the following elements: Scaffolding systems- this is a system of OSHA approved commercially available portable free standing scaffold to be used for personnel access to the detector for assembly and maintenance requirements. Some non-standard systems may have to be incorporated in the design for complete access to the detector. The majority of its use will be during long term shutdowns or multiple day maintenance activities when adequate time is required to erect and remove the scaffold system. This would include the cost of specification, design, procurement, and delivery of all system hardware for the experiment. Stairs and walkways- this is a system of permanent structures incorporated into the experiment and its related subsystems to allow immediate personnel access to detector components for short term servicing and maintenance. These systems would have to meet OSHA approved standards and would include walkways over the experimental pit, access stairways and ladders, and elevated walkways. . This would include the cost of specification, design, procurement, and delivery of all system hardware for the experiment.

| WBS | Description |
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| Number | Description |
| 1.2.10.3.4.1.2 | Conceptual Design Review |
| 1.2.10.3.4.1.3 | Engineering |
| 1.2.10.3.4.1.4 | Design |
| 1.2.10.3.4.1.5 | Procurement |
| 1.2.10.3.4.1.6 | Fabrication |
| 1.2.10.3.4.2 | Stairs and Walkways |
| 1.2.10.3.4.2.1 | Concept Specification |
| 1.2.10.3.4.2.2 | Conceptual Design Review |
| 1.2.10.3.4.2.3 | Engineering |
| 1.2.10.3.4.2.4 | Design |
| 1.2.10.3.4.2.5 | Procurement |
| 1.2.10.3.4.2.6 | Fabrication |
| 1.2.10.3.5 | Management Activities |
| | This element includes the cost for the overall coordination and management of the day-to-day and long term conventional systems activities. Included is the cost of an onsite manager, engineering, design drafting, and clerical support. |
| 1.2.10.3.5.1 | Pre-construction Effort |
| 1.2.10.3.5.2 | Manager |
| 1.2.10.3.5.3 | Engineering |
| 1.2.10.3.5.4 | Administration |
| 1.2.10.3.5.5 | Procurement |
| 1.2.10.3.5.5.1 | MSTS FY06 |

| WBS | Description |
|-----------------|---|
| Number | Description |
| 1.2.10.3.5.5.2 | MSTS FY07 |
| 1.2.10.3.5.5.3 | MSTS FY08 |
| 1.2.10.3.5.5.4 | MSTS FY09 |
| 1.2.10.3.5.5.5 | MSTS FY10 |
| 1.2.10.3.5.5.6 | Computer Hardware/Software FY06 |
| 1.2.10.3.5.5.7 | Computer Hardware/Software FY07 |
| 1.2.10.3.5.5.8 | Computer Hardware/Software FY08 |
| 1.2.10.3.5.5.9 | Computer Hardware/Software FY09 |
| 1.2.10.3.5.5.10 | Computer Hardware/Software FY10 |
| 1.2.10.4 | Testing & Commissioning |
| | This includes the cost and schedule of all labor required for testing and commissioning the baseline KOPIO Detector in the Collider-Accelerator (C-A) experimental floor, Bldg. 912. System testing and commissioning consists of the following elements: Testing, Commissioning, Management activities. |
| 1.2.10.4.1 | Testing |
| | This element includes all labor costs associated with the testing of all detector subsystems and system tests once it has entered the C-A experimental floor at BNL. These tests can range from acceptance inspection and test of procurement deliverables through pre-operational testing of subsystems prior to commissioning. Costs for continuation of engineering and technical support of a detector subsystem by the home institution are not covered by this element. This element does not include the cost of planning the test activities of individual detector subsystems. |
| 1.2.10.4.1.1 | Conceptual Planning |
| 1.2.10.4.1.2 | Conceptual Design Review |
| 1.2.10.4.2 | Commissioning |

| WBS Number | Description |
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| | <p>This element includes all labor costs associated with the commissioning of the KOPIO Detector and its combined subsystems as a whole once the detector installation is complete and individual subsystem testing is completed on the experimental floor. The scope of these commissioning efforts would include full experimental pre-operational testing and engineering beam studies of the beam transport with experimental detector. Costs for continuation of engineering and technical support of a detector subsystem by the home institution are not covered by this element. This element does not include the cost of planning the commissioning activities of individual detector subsystems or beam transport subsystems.</p> |
| 1.2.10.4.2.1 | Conceptual Planning |
| 1.2.10.4.2.2 | Conceptual Design Review |
| 1.2.10.4.3 | Management Activities |
| | <p>This element includes the cost for the overall coordination and management of the day-to-day and long term Testing and Commissioning activities. Included is the cost of an onsite testing and commissioning manager, engineering, and clerical support.</p> |
| 1.2.10.4.3.1 | Pre-construction Effort |
| 1.2.10.4.5.2 | Manager |
| 1.2.10.4.5.4 | Administration |
| 1.2.10.4.5.5 | Procurement |
| 1.2.10.4.5.5.1 | MSTS FY06 |
| 1.2.10.4.5.5.2 | MSTS FY07 |
| 1.2.10.4.5.5.3 | MSTS FY08 |
| 1.2.10.4.5.5.4 | MSTS FY09 |
| 1.2.10.4.5.5.5 | MSTS FY10 |
| 1.2.10.4.5.5.6 | Computer Hardware/Software FY06 |
| 1.2.10.4.5.5.7 | Computer Hardware/Software FY07 |

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| WBS | Description |
|-----------------|---------------------------------|
| Number | |
| 1.2.10.4.5.5.8 | Computer Hardware/Software FY08 |
| 1.2.10.4.5.5.9 | Computer Hardware/Software FY09 |
| 1.2.10.4.5.5.10 | Computer Hardware/Software FY10 |