National Aeronautics and
Space Administration

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March 28, 2016

Reply to Attn of: QSH

U.S. Nuclear Regulatory Commission
Director, Office of Federal and State Materials
and Environmental Management Program
Attn: Document Control Desk
Washington, DC 20555-0001

Subject: Re-evaluation of Need for Decommissioning Plan Per 10 Code of Federal Regulations (CFR) 30.36(g)(1)

Ref: License #34-00507-16, Docket #030-05626

Under the cover of a letter dated June 8, 2015, the NASA Glenn Research Center (GRC) submitted a Decommissioning Plan (DP) and associated administrative procedure to address the future decommissioning of its shutdown Cyclotron Facility, also known as Building 140. The GRC has continued to gather information about the radiological source term presented by this facility. Based upon data from continued site characterization efforts, including subsurface soil sampling and more extensive surveys of machine/equipment internal conditions, additional insight on possible methods/techniques to size-reduce large articles and building structure, management of source term components, as well as guidance from Commission staff, the GRC now believes that anticipated activities involved with the decontamination and decommissioning (D&D) of its Cyclotron Facility will not result in a significant impact to the health or safety of workers, the public or the environment. Descriptions of the site's relevant radiological conditions and the past and on-going work efforts are provided below. In addition, summaries of radiological exposure estimates for both workers and the public is presented.

- **Description of Radiological Source Term**

  Nearly all of the source term within the Cyclotron Facility is comprised of activated machine components as well as activated concrete within the cyclotron vault room. Gamma spectral analysis of such materials have shown the presence of certain activation products, most notably Cobalt-60 (Co-60) and Europium-152 (Eu-152). Maximum and average radionuclide concentrations within these media are summarized in Enclosure 1 of this letter. Most of these materials have on-contact measurable dose rates at or near background radiation levels. A limited number of smaller components or spots within the cyclotron

NM5501

machine or beam line have much higher on-contact dose rates, most on the order of a few millirem per hour (mrem/h) and, in one instance, up to 100 mrem/h. Management of these items has included segregation and/or shielding to make general area dose rates as low as reasonable achievable. Most of these "higher" activity items have been removed as interferences and will be shipped for disposal sometime in mid-2016. The Nuclear Regulatory Commission (NRC) Region III staff will be notified of this scheduled event once a date has been established.

Recent subsurface soil sampling performed to look for possible activation in the soil adjacent to the concrete walls and ceiling of the underground cyclotron vault, have shown a low-level of an activation radionuclide in one location. For reference purposes only, the concentration measured in this one subsurface location was less than 10 percent of the NRCs surface soil screening value for the subject radionuclide, Eu-152. Based on this result, the GRC recognizes the potential for similar concentrations in soil around the structure, especially under the floor near the machine which has not yet been surveyed.

Most of the activated materials characterized and surveyed thus far have not been shown to have removable contamination. Some internal surfaces of the cyclotron machine have been found to have limited removable contamination, up to 1,000 dpm β/γ in almost all instances. Any surfaces on items removed from the system have been properly bagged and labeled with plans to ship for disposal in mid-2016 as described above.

- **Past, Ongoing and Near-Future Work Activities**

  During the past 2-3 years, work activities in the Cyclotron Facility have been performed on a part-time basis by two members of the health physics staff, averaging 80 to 90 hours per month (total), under written work procedures and job hazard analyses. The scope of work has focused on radiological characterization as well as removal of equipment and interferences using mechanical means. Non-activated materials removed from the facility were surveyed for contamination and released for unrestricted use (i.e. "free-released) in accordance with current license conditions. The majority of activated materials that have been removed thus far qualify for disposal via the state of Tennessee's Bulk Survey for Release Program (BSRP), which was developed to have a standardized process for analyzing materials with extremely low levels of radioactive contamination for disposal in specified Class I landfills. One such shipment took place in August of 2015, whereby 10 B-25 containers with approximately 40,000 pounds of material were shipped for disposal. A second shipping campaign is planned for mid-2016 which will include more of the low-level materials for Tennessee's BSRP along with materials slated for separate disposal paths, such as low-level radioactive waste and mixed low-level waste.

- **Worker Exposure from External Radiation**

  The majority of the interference removal work and radiological characterization performed since 2013 has involved two individuals from NASA GRCs health physics staff. The work effort is neither constant nor consistent, but average monthly work hours for this effort are

estimated to be between 80 and 90 hours total for the two persons (i.e. 40-45 hours each). Quarterly whole body dosimeter readings for these individuals has been below the established administrative dose threshold of 5 millirem (mrem) during all monitoring periods except for the second quarter of 2015 when one individual's dosimeter read 13 mrem. It should be noted that this dose could also be due to exposure during non-cyclotron work activities.

Workers' external radiation exposures (i.e. "deep dose equivalent" or DDE) from future work activities involving the disassembly and size segmentation of the cyclotron machine and infrastructure are expected to be on par with those doses recorded during the past couple years and well below the monitoring threshold cited in 10 CFR 20.1502.

- **Worker Exposure From Uptake of Radionuclides**

  Methods used to size-reduce activated concrete and metal have the potential to generate airborne radioactivity because of dust/particles that maybe released. Enclosure 1 to this letter, includes a detailed description of assumptions and calculations performed to estimate worker exposure from inhalation of these concrete dust and metal fume particles. The estimated committed effective dose equivalent (CEDE) from both uptake of concrete dust and metal fume particles are 1.2 mrem and 0.005 mrem, respectively.

  As far as the low-level activated soil, the NASA GRC does not believe that the excavation and movement of this soil during D&D activities presents a significant health hazard to workers. First, the quantity of activated soil is limited. Second, the concentration activation product is low. Finally, the highly-dense and silt-rich clay composition of the soil would limit its tendency to break apart into particles small enough to be made airborne by prevailing winds.

- **Public Exposure**

  The NASA will limit dose contributions to the general public from cyclotron materials and activities by complying with all applicable NRC regulations, controlling access to cyclotron work areas, performing radiological surveys, and posting of radiological areas.

  Because of the limited source term and through proper management of the licensed materials during D&D activities, the NASA GRC believes that external radiation doses to individual members of the public will be well below limits established in 10 CFR 20.1301. Area radiation dosimeters will be strategically placed outside the Building 140 radiological controlled area prior to commencing major D&D activities in an effort to monitor radiation conditions in environmental areas and other areas accessible by the public.

  For the case of inhalation doses, NASA will limit, in accordance with as low as is reasonable achievable requirements of 10 CFR Part 20.1101, air emissions to the environment such that the individual member of the public likely to receive the highest dose will not be expected to receive a total effective dose equivalent (TEDE) in excess of 10 mrem per year from these emissions. Conservative estimates of TEDE from uptake of concrete dust and metal fume

particles liberated from the site during D&D activities are a small fraction of 1 mrem as shown in Enclosure 1. For reasons described in the section above, the NASA GRC also believes that any contribution of TEDE from inhalation of activated soil will also be trivial.

So, while some of the anticipated procedures and activities necessary to carry out the decommissioning of the GRC Cyclotron Facility have not been previously approved by the Commission and these procedures could increase potential health and safety impacts to workers or to the public, it is the contention of the NASA GRC that such impacts will not be significant and a DP is no longer required for this activity as described in 10 CFR 30.36(g)(1). Therefore, the NASA GRC would like to rescind its D-plan submitted under its licensing amendment request dated June 8, 2015.

The NASA still recognizes the need for NRC approval of work activities not previously approved when merited by potential radiological impacts. As described in this same June 8, 2015, letter to the Commission, NASA requests that an administrative procedure, AD-01, "Creation, Revision, Approval and Cancellation of GRC Cyclotron Decommissioning Project Plans, Procedures and Documents," be accepted by the NRC to allow the GRC to approve and implement its own procedures/plans for activities involving licensed materials as part of its Cyclotron Facility D&D project. Revision 1 of the AD-01 procedure is provided as Enclosure 2.

Assuming that an NRC-approved D-plan is not, in fact, required for the GRC Cyclotron Facility D&D project, NASA also assumes that an NRC-approved Final Status Survey Plan will not be required. The NASA GRC will perform the necessary surveys to satisfy requirements of 10 CFR 30.36(j)(2) and can provide the Commission with appropriate notification, if so desired, to allow for confirmatory sampling and surveillance.

Should additional information be required, please contact Mr. Christopher J. Blasio, Radiation Safety Officer, at (216) 433-6520.

Mark M. Kowaleski
Chief, Safety and Health Division

Gene L. Stygles
Chief, Facilities Division

2 Enclosures:
1. Estimate of Internal Exposures from Size Reducing Metal and Concrete
2. AD-01, "Creation, Revision, Approval, and Cancellation of GRC Cyclotron Decommissioning Project Plans, Procedures and Documents"

cc:
U.S. NRC, Region III/Materials Control, Decommissioning Branch/M. LaFranzo
Material Licensing

Estimate of Internal Exposures From Size Reducing Metal and Concrete

Bounding the Radiological Source Term

The overwhelming majority of the radiological source term at the GRC Cyclotron Facility is found in activated concrete and metal. Within these activated materials, the radionuclides of significance are Europium-152 and Cobalt-60 within concrete and Cobalt-60 within metal. With a couple of known exceptions, all of these activated materials are located within the structural volume of the Cyclotron Vault (Room 002). The foot print of this room is approximately 2,195 ft^2 (42-ft x 52.25-ft) with an airspace volume of 50, 839 ft^3 (Area x 23.17-ft height). Intact, the activated concrete and metals do not offer the potential for internal, or, committed dose to workers or the public. Methodologies utilized to size reduce these materials during demolition or deconstruction activities do have the potential to create a radiological inhalation hazard.

Concrete

The walls, floor and ceiling of the Cyclotron Vault (Room 002) were the only concrete structures identified as being activated during site characterization activities. Demolition of said concrete structures will result in the generation of concrete dust containing activation products. With the objective of offsite disposal of this concrete room, NASA has considered two methods of destruction: size reduction using "yellow gear" (large-scale jack hammers and brute mechanical force) and segmentation by saw/wire cutting (wetting techniques used in both). While either general method may be used, for the purposes of this hazard analysis NASA will consider the method wherein more dust will be generated. Based upon dust-generation information found in [AP 42 - fifth edition, EPA 1995] for tertiary crushing of limestone, NASA believe that saw/wire cutting of concrete will produce far more concrete fines.

In order to provide an estimate of the airborne radionuclide contamination, the following assumptions were made. While the thicknesses of the Vault's floor, ceiling and walls range from 8 inches to 60 inches, we will assume that the total concrete volume of these structures, 14,681 ft^3 is present as a 1-foot thick slab. For the purposes of estimating the amount of dust generated, assume that this 14,681 ft^2 area will be cut into approximately 587 segments, measuring 5-ft x 5-ft, each with a 4 inch cored hole to facilitate lifting. Each segment will, on average, require 10 linear feet of concrete cutting (i.e. half the perimeter assuming two shared sides). Assuming a concrete saw blade width of $^1/_4$ inch and a coring blade width of $^1/_8$ inch, the total volume of solid concrete reduced to dust is estimated to be 135 ft^3, or 3.82 x 10^6 cm^3.

$$\text{Concrete Saw/Wire Cutting Dust} = 5{,}870ft \times \frac{0.25}{12} ft \times 1ft = 122\ ft^3$$

$$\text{Concrete Coring Dust} = 587 \times \pi \times [4^2 - 3.875^2] in^2 \times 12in \times \frac{ft^3}{1{,}728in^3} = 13ft^3$$

If one assumes a solid concrete density of 2.4 g/cm^3, the corresponding mass of generated dust will be 9.17 x 10^6 g.

During the 2010-2011 characterization study performed at the site, 98% of the Vault concrete samples analyzed showed a Europium-152 content above the 0.24 pCi/g MDA. The maximum and average Eu-152 concentrations were 4.97 and 1.45 pCi/g, respectively. Only 34% of these same samples showed Cobalt-60 concentrations above the 0.09 pCi/g MDA and the maximum and average of this 34% subset were 1.38 and 0.42 pCi/g, respectively. Assuming all of the concrete dust generated, 9.17 x 10^5 g, has Eu-152 and Co-60 concentrations equal to the maximum levels found during the 2011 characterization study, which have been decay corrected to May 2015, then the total radiological source term represented by this quantity of dust would be 3.69 x 10^7 pCi of Eu-152 and 6.97 x 10^6 pCi of Co-60.

$$\text{Eu152 in Concrete Dust } = 4.97\frac{pCi}{g}\exp(-\frac{ln2\cdot 4.13y}{13.54y}) \times 9.17\cdot 10^6\text{g} = 3.69\cdot 10^7 pCi = 36.87\mu Ci$$

$$\text{Co60 in Concrete Dust } = 1.38\frac{pCi}{g}\exp\left(-\frac{ln2\cdot 4.25y}{5.27y}\right) \times 9.17\cdot 10^6\text{g} = 6.97\cdot 10^6 pCi = 6.97\mu Ci$$

Metals

The largest, by mass, of the activated metal components within the Cyclotron Vault are the 4 solid yoke pieces, upper, lower and 2 sides, along with the top and bottom magnets, whose total mass is on the order of 230 tons. NASA anticipates that these pieces will be removed from the facility in-tact. If the Decommissioning Contractor does decide to size reduce the yoke pieces, it would likely be by a sawing technique, which would not generate airborne radioactive contaminants. NASA also anticipates being able to size reduce most, if not all, of the other large-scale activated metal components using methods, such as mechanical disassembly, saw cutting and shearing, which do not create airborne radioactive contamination. Most notable of these large items are a 12-ft x 16-ft reinforced plate steel door and two 52-ft long I-beams which span the length of the bridge crane.

For the sake of conservative hazard analysis, NASA will assume that the above-mentioned steel door and I-beams will be size-reduced by torch cutting; a method that will results in a metal fume containing activation products. Cutting the large door into 4-ft x 4-ft sections would require 84 feet of torch cutting for the door plate itself. This 84-ft length will be doubled to account for cutting the reinforcing members of the door. The crane bridge I-beams have a 9"-wide x 24"-tall profile. If the I-beams were cut into sections that were approximately 5-feet long, there would be 9 cuts made per I-beam, resulting in a total torch cutting length of 63 feet. The total length of metal being cut would be 231 feet. Assuming a steel thickness of $^5/_8$" and torch-cutting width of $^1/_4$", the volume of ablated metal can be calculated to be 433 in^3 or 7.10 x 10^3 cm^3.

$$\text{Ablated steel volume } = 231ft \times \frac{12\ in}{ft} \times 0.25\ in \times 0.625\ in = 433\ in^3$$

If one assumes a steel density of 7.85 g/cm^3, the corresponding mass of this steel will be 5.57 x 10^4 g. In May 2015, a representative coupon of the shield door was determined to have a Co-60 concentration of 0.48 pCi/g. Applying this activity level to the shield door and crane I-beam steel proposed as being torch cut in this example yields a total activity released of 2.67 x 10^4 pCi.

$$\text{Co60 in Metal Fumes } = 048\frac{pCi}{g} \times 5.57\cdot 10^4\text{g} = 2.67\cdot 10^4 pCi = 0.03\mu Ci$$

Worker/Occupational Internal Dose

The concrete and steel size reduction methods will be performed in a relatively open work environment with controls to limit occupational exposure to airborne and hazardous contaminants. Said controls can include wetting methods, local exhaust ventilation and personal protective equipment. The following calculations of airborne radiological contamination are used to estimate committed effective dose equivalent (CEDE) to employees engaged in the subject demolition activities. A general dilution ventilation relationship will be used which assumes (1) that the source term is generated evenly throughout the work day; (2) that the source term is confined to a space with the volume of the Vault (V=50, 839 ft^3 or 1,440 m^3) and (3) there is minimal amount of effective dilution ventilation present, specifically 1 "room"-volume air exchange per hour (1,440 m^3/hr or 0.4

m^3/s). NASA believes that the actual effect of dilution ventilation would be much greater based upon the average wind speed of 4.45 m/s for this location published by the US Department of Agriculture in 2003.

$$C(t) = \frac{G}{Q}\left(1 - e^{-\frac{Q}{V}t}\right)\left(\frac{1}{10^6}\right)$$

Where:

C = concentration in $\frac{\mu Ci}{mL}$ at time t in seconds (s)
G = contaminant generation rate in $\frac{\mu Ci}{s}$
Q = effective ventilation rate in $\frac{m^3}{s}$
V = room volume in m^3
t = time in seconds (s)

After a certain period of time, the concentration relationship builds to the asymptotic level of C = G/Q. These concentrations will be compared with Derived Air Concentration (DAC) information provided in Table 1 of 10 CFR 20 Appendix B to estimate workers' doses from inhalation.

Concrete

NASA believes that all concrete cutting for the Cyclotron Vault room's floor, ceiling and walls can be completed in 20 work days, or, 160 work hours. Also, consistent with available industrial hygiene studies reviewed by the Center for Protection of Workers' Rights in 2009, NASA believes that the use of water during saw cutting will be as effective at reducing airborne radionuclide contamination as the 85+% reduction observed for dusts and resipirable silica. Consequently, the airborne Eu-152 and Co-60 concentrations are estimated as:

$$C_{Eu152} = \frac{0.15 \times \left({}^{36.9\mu Ci}/_{160 \times 3600s}\right)}{0.4\frac{m^3}{s}} \frac{m^3}{10^6 mL} = 2.4 \times 10^{-11}\frac{\mu Ci}{mL}$$

$$C_{Co60} = \frac{0.15 \times \left({}^{7.0\mu Ci}/_{160 \times 3600s}\right)}{0.4\frac{m^3}{s}} \frac{m^3}{10^6 mL} = 4.5 \times 10^{-12}\frac{\mu Ci}{mL}$$

As specified in Appendix B of 10 CFR Part 20, the Derived Air Concentration (DAC) for Eu-152 and Co-60 (class Y) are both 1 x 10^{-8} µCi/mL. Based upon the assumptions in this appendix B, one can estimate a committed dose of 2.5 mrem for each DAC-hour of exposure. The estimated doses from inhalation of these Eu-152 and Co-60 concentrations can be calculated as follows:

$$CEDE_{Eu152} = \left(\frac{1.0 \times 10^{-8}\frac{\mu Ci}{mL}}{2.4 \times 10^{-11}\frac{\mu Ci}{mL}}\right)\frac{2.5\,mrem}{hr}\,160\,hrs = 1.0\,mrem$$

$$CEDE_{Co60} = \left(\frac{1.0 \times 10^{-8}\frac{\mu Ci}{mL}}{4.5 \times 10^{-12}\frac{\mu Ci}{mL}}\right)\frac{2.5\,mrem}{hr}\,160\,hrs = 0.2\,mrem$$

Metals

Based upon readily available charts for the speed of cutting $^5/_8$-in thick steel with hand oxygen-acetylene torch, NASA believes that all such torch cutting for the inner water door and the crane I-beams would be completed in a single 8-hour work day. Consequently, the airborne Co-60 concentration is estimated as:

$$C_{Co60} = \frac{(0.027\mu Ci/8 \times 3600s)}{0.4\frac{m^3}{s}} \frac{m^3}{10^6 mL} = 2.3 \times 10^{-12}\frac{\mu Ci}{mL}$$

As specified in Appendix B of 10 CFR Part 20, the Derived Air Concentration (DAC) for Co-60 (class Y) is 1 x 10^{-8} µCi/mL. Based upon the assumptions in this appendix B, one can estimate a committed dose of 2.5 mrem for each DAC-hour of exposure. The estimated dose from inhalation of this Co-60 concentration can be calculated as follows:

$$CEDE_{Co60} = \left(\frac{1.0 \times 10^{-8}\frac{\mu Ci}{mL}}{2.3 \times 10^{-12}\frac{\mu Ci}{mL}}\right) \frac{2.5\ mrem}{hr}\ 8\ hrs = 0.005\ mrem$$

Dose to the General Public

NASA will limit dose contributions to the general public from cyclotron materials and activities by complying with all applicable NRC regulations, controlling access to cyclotron work areas, performing radiological surveys, and posting of radiological areas. For the case of inhalation doses, NASA will limit, in accordance with ALARA requirements of 10 CFR Part 20.1101, air emissions to the environment such that the individual member of the public likely to receive the highest dose will not be expected to receive a total effective dose equivalent in excess of 10 mrem per year from these emissions.

NASA will utilize the basic equation of the Gaussian plume model and associated guidance included NUREG/CR-6410 to estimate downwind airborne radionuclide concentrations. These levels will be compared with Table 2, Column 1 of 10 CFR Part 20 concentrations for allowable airborne effluent concentrations to estimate inhalation doses to the general public.

$$C(x,y,z) = \frac{Q_r}{2\pi u\sigma_y\sigma_z} exp\left(-\frac{y^2}{2\sigma_y^2}\right)\left\{exp\left(-\frac{(z-H_e)^2)}{2\sigma_z^2}\right) + exp\left(-\frac{(z+H_e)^2)}{2\sigma_z^2}\right)\right\}$$

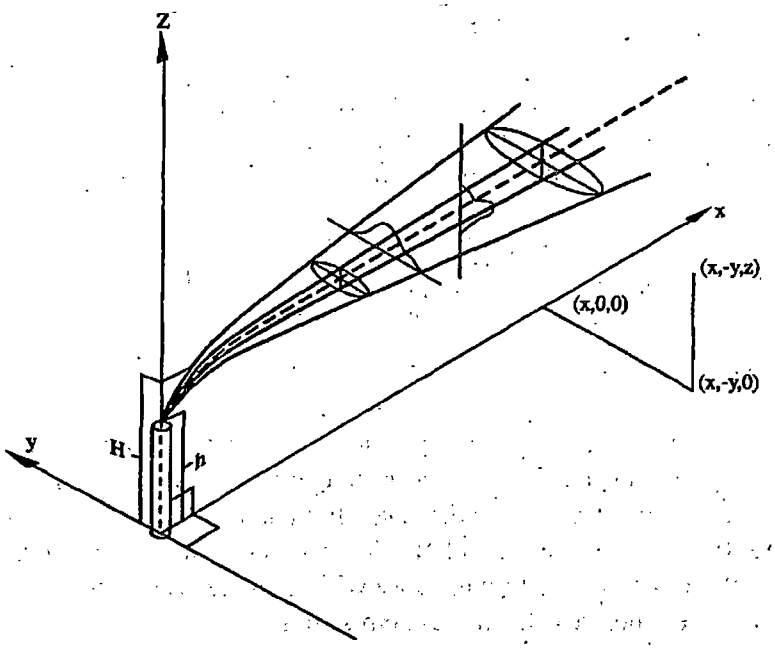
Where:
C = concentration of pollutant at point (x,y,z) (Ci/m3)
Q_r = release rate (Ci/s)
u = mean plume velocity along x-axis (m/s)
σ_y, σ_z = standard deviations of distribution C in the y and z directions, respectively (m)
x = distance downwind (m)
He = effective release height of pollutant (m)
y = horizontal location at right angles to plume axis, with y equal to zero on the axis (m)
z = height above ground (m)

Gaussian model is displayed in Figure 7-1

There are use restrictions applicable to the Gaussian plume model which include assumptions regarding environmental conditions as described in NUREG/CR-6410. NASA is aware of the practical limitations described within the NUREG for these assumptions of conditions along with the associated practical

consequences. NASA's use of the modeling equations is primarily focused on obtaining a worse-case type exposure scenario for an off-site receptor rather than a realistic estimate of airborne contamination.

Gaussian Plume Model



The following values were used in Gaussian plume equation:

The release rate, Q_r, was generated by dividing the respective radiological source term by the period of release which includes the inherent assumption that the radioisotope was uniformly released over this period.

The mean plume velocity, u, used is the average wind speed measured at Cleveland Hopkins Airport (CLE), which is adjacent to NASA, during the months of March through October from 1961 to 1990 as reported by the US Department of Agriculture in 2003. (u=4.45 m/s) NASA assumes that u is constant and that the direction of wind does not change.

In estimating the values of the y- and z-direction standard deviations of the distribution, NASA assumes the most stable environmental conditions, Class F, which will result in the least amount of plume spread and, consequently, the highest downwind concentrations. Table 5-5 from NUREG/CR-6410 [SAIC 1998] provides the following equations for estimating Class F σ_y and σ_z for an urban environment.

$$\sigma_y = \frac{0.11x}{\sqrt{1 + 0.0004x}} \qquad \sigma_z = \frac{0.08x}{\sqrt{1 + 0.00015x}}$$

An effective release height, He, of zero was used since the release is at or below ground level and there is no upward velocity component to the emission.

The variables x, y and z are set to 100m, 0m, and 2m, respectively. The x-distance of 100m represents the approximate distance to the nearest offsite building which belongs to CLE. The y-value is set to 0m to limit off-axis dispersion effects. A value of 2m for the z-variable is used to estimate the breathing height of the offsite receptor.

Concrete

The radiological source terms from the concrete dust were previously identified to be 3.69 x 10^7 pCi of Eu-152 and 6.97 x 10^6 pCi of Co-60. Again, we assume that wetting methods reduces the fraction going airborne to approximately 15% and that this generation occurs over a 160 hour time period. The Gaussian plume model equations would, for steady state conditions, estimate our Eu-152 and Co-60 concentrations to be:

$$C_{Eu152}(100,0,2) = 7.8 \times 10^{-15} \frac{Ci}{m^3} \; or \; \frac{\mu Ci}{mL}$$

$$C_{Co60}(100,0,2) = 1.5 \times 10^{-15} \frac{Ci}{m^3} \; or \; \frac{\mu Ci}{mL}$$

Table 2, Column 1 of 10 CFR Part 20 Appendix B [NRC 2010] provides average airborne effluent concentrations which, if inhaled continuously over a 1-year period by a member of the public, would result in a CEDE of 50 mrem. The Table 2 values for Eu-152 and Co-60 (class Y) can be used to estimate the inhalation dose for the NASA offsite receptor due to inhalation of concrete dust.

$$CEDE_{Eu152} = \left(\frac{7.8 \times 10^{-15} \frac{\mu Ci}{mL}}{3.0 \times 10^{-11} \frac{\mu Ci}{mL}}\right) \frac{50 \; mrem}{365 \times 24 hr} \; 160 \; hrs = 0.0024 \; mrem$$

$$CEDE_{Co60} = \left(\frac{1.5 \times 10^{-15} \frac{\mu Ci}{mL}}{5.0 \times 10^{-11} \frac{\mu Ci}{mL}}\right) \frac{50 \; mrem}{365 \times 24 hr} \; 160 \; hrs = 0.0003 \; mrem$$

Metals

The radiological source term for the torch-cut metal was previously identified to be 2.67 x 10^4 pCi of Co-60. The Gaussian plume model equation would, for steady state conditions, estimate our Co-60 concentration to be:

$$C_{Co60}(100,0,2) = 7.5 \times 10^{-16} \frac{Ci}{m^3} \; or \; \frac{\mu Ci}{mL}$$

Table 2, Column 1 of 10 CFR Part 20 Appendix B [NRC 2010] provides average airborne effluent concentrations which, if inhaled continuously over a 1-year period by a member of the public, would result in a CEDE of 50 mrem. The Table 2 value for Co-60 (class Y) can be used to estimate inhalation dose for the NASA offsite receptor due to inhalation of metal fume.

$$CEDE_{Co60} = \left(\frac{7.5 \times 10^{-16} \frac{\mu Ci}{mL}}{5.0 \times 10^{-11} \frac{\mu Ci}{mL}}\right) \frac{50 \; mrem}{365 \times 24 hr} \; 8 \; hrs = 6.8 \times 10^{-7} \; mrem$$

NASA Glenn Research Center
Cyclotron Decommissioning Project

Creation, Revision, Approval, and Cancellation of GRC Cyclotron Decommissioning Project Plans, Procedures and Documents

AD-01 (CYC)
Revision 1

GRC CYCLOTRON DECOMMISSIONING PROJECT ROUTING AND APPROVAL SHEET

Document Title: Creation, Revision, Approval and Cancellation of GRC Cyclotron Decommissioning Project Plans, Procedures and Documents

Document Number: AD-01 (CYC) **Revision Number:** Rev 1

ROUTING

	Signature	Date
Originator	**R. Case /**	3/22/16
Review and Concurrence:		
Independent Technical Reviewer	**C. Blasio /**	3/22/2016
NASA GRC Radiation Safety Officer	**C. Blasio /**	3/22/2016
NASA Cyclotron Decommissioning Project Manager	**D. Ebner /**	3/23/2016

IMPLEMENTING APPROVAL: _____ _____
Signature **Date**

EFFECTIVE DATE: _____

NASA GRC CYCLOTRON DECOMMISSIONING PROJECT CHANGE/CANCELLATION RECORD		
DOCUMENT TITLE: Creation, Revision, Approval and Cancellation of GRC Cyclotron Decommissioning Project Plans, Procedures and Documents.	**DOCUMENT NO:** AD-01 (CYC)	**REVISION NO:** Rev 1
Revision 0: Initial issue of Procedure. (June 2, 2015)		
Revision 1: Removed references to the Decommissioning Plan as it has been determined that a NRC approved D-Plan is not necessary for this project. Removed Temporary Change Notice (TCN) section as it is not anticipated that a TCN would be useful or necessary. Simplified copy management by eliminating references to various copy types which were seen as unnecessary. Clarified electronic document management. Minor wording and format changes for consistency and readability. (March 22, 2016)		

LIST OF EFFECTIVE PAGES

DOCUMENT NO: AD-01 (CYC) **REVISION NO: 1**

Page No.	Revision Level	Page No.	Revision Level	Page No.	Revision Level
Cover Page	1				
Routing Page	1				
Change Record	1				
LOEP	1				
Pages 1 thru 10	1				
App A, Pages 1 thru 1	1				
App B, Pages 1 thru 5	1				
App C, Pages 1 thru 7	1				
Exhibit 1, Pages 1thru 2	1				
Exhibit 2, Pages 1 thru 2	1				
Exhibit 3, Pages 1 thru 2	1				
Exhibit 4, Pages 1 thru 2	1				
Exhibit 5, Pages 1 thru 2	1				
Exhibit 6, Pages 1 thru 3	1				
Exhibit 7, Pages 1 thru 1	1				

1.0 INTRODUCTION

1.1 Purpose

Procedure AD-01 describes the process associated with the development, review, approval, implementation, and cancelation of Plans, Procedures, and Work Execution Packages (WEPs) for licensed decommissioning activities associated with the Glenn Research Center (GRC) Cyclotron Facility. Because of the level of technical and radiological safety review built into this process, documents generated using AD-01 criteria do not require specific approval by the Nuclear Regulatory Commission (NRC). Rather, this procedure itself will become a tie-down document in the GRC radioactive materials license. As such, AD-01 will govern how Cyclotron decontamination and decommissioning (D&D) Project Plans, Procedures, other than AD-01 itself, and Work Execution Packages will be developed and approved. Any substantive changes to AD-01 will require NRC review and approval via a licensing amendment action.

1.2 Scope

This procedure shall be used for the development, review, approval, implementation, and cancelation of Plans, Procedures, and Work Execution Packages (WEPs) for licensed decommissioning activities associated with the Glenn Research Center (GRC) Cyclotron Facility. It applies to documents created or revised after the implementation date of this procedure.

The AD-01 process may also be used for Plans, Procedures, WEPs or other Cyclotron Decommissioning Project documents covering non-licensed activities. For such applications, the review/approval component of the AD-01 process will vary, as needed, to satisfy GRC requirements and ensure appropriate stakeholder involvement.

In support of other on-going activities at the Center, Health Physics Procedures (HPP) have been developed and implemented. Procedures similar to these existing HPPs will be needed to cover Cyclotron decommissioning activities. Rather than duplicate procedures, those identified as necessary for Cyclotron work will be updated, if needed, and then reviewed and approved per AD-01. The Title, Routing/Approval, Change/Cancellation, and List of Effective Pages prescribed by AD-01 will be placed at the front of these accepted HPPs.

For Procedures only, the text "(CYC)" will be added to the document number to differentiate those procedures covering Cyclotron Decommissioning Project activities from others.

2.0 REFERENCES

2.1 Applicable Documents

2.1.1 NASA Record Retention Schedule (NRSS) 1441.1 (as revised) as implemented in NASA Procedural Requirements (NPR) 1441.1E "NASA Records Management Program Requirements".

2.2 Records

2.2.1 Originals and all revisions of GRC Cyclotron Plans, Procedures, and Work Execution Packages.

2.2.2 Completed Work Execution Packages containing all data collected or recorded during performance of the specified work activity, and the daily work logs.

2.2.3 GRC Cyclotron Facility Document Control Log (Exhibit 7) containing procedure numbers, Work Execution Package numbers, and revision numbers assigned that allow administratively tracking documents through the preparation, review, and approval process.

2.3 Definitions

2.3.1 Affected Organization - Any organization, whose work is impacted by the document being issued, revised or cancelled.

2.3.2 Document Change Package – An official record copy of a procedure or document that is maintained for the life of the Project. The Document Change Packages provide a single historical record of a document and its subsequent revisions.

2.3.3 Effective Date – The date, assigned by the Cyclotron Decommissioning Project Manager (or designee), on which compliance with a document becomes mandatory.

2.3.4 Hard Copy Original – A reproducible paper copy of a final approved and issued document, with original signatures

2.3.5 Independent Technical Review/Reviewer – An Independent Technical Review is a review performed by a designated individual to verify the technical adequacy and correctness of a document. An Independent Technical Reviewer (ITR) is an individual who is knowledgeable of the area under consideration, and was not substantively involved in the preparation of the document under review. When the assigned ITR deems appropriate, he/she obtains a cross disciplinary review from other qualified individuals. If more than one individual is involved in the Independent Technical Review, the ITR is the individual whose signature attests that the Independent Review has been adequately performed.

2.3.6 Plans– Plans are higher tier documents that describe in more general terms the overall controls that are going to be used in the performance of the Project. They discuss general terms and conditions and describe the codes, standards, regulations, and overall project performance criteria that will be implemented through more detailed and specific lower tier procedures.

2.3.7 Procedures – Procedures are documents that provide step-by-step directions and instructions prescribing the performance of activities or the administration of project activities. They are prescriptive in nature and govern standard recurrent activities such as radiological surveys, operation of facility equipment, and performance of periodic surveillances.

2.3.8 Work Execution Packages (WEP) – Work Execution Packages are work authorizing and control documents and task performance procedures that provide instructions and criteria for the performance of field activities associated with decommissioning tasks. In addition, they may be used as design change control documents to support engineering, construction, test, and installation activities to support system and structure design changes.

3.0 RESPONSIBILITIES

3.1 Cyclotron Decommissioning Project Manager

The Cyclotron Decommissioning Project Manager (or designee) is responsible for the final approval and assignment of an effective date for all documents.

3.2 Originator

The originator is responsible for the technical accuracy of all information provided in the document, for obtaining the assistance and input from any organizations or individuals necessary to assure the technical accuracy, preparation of all forms and administrative records in conformance with the requirements of this procedure, and for assuring that all applicable document requirements and commitments are adequately and clearly incorporated into the document.

3.3 Reviewers

3.3.1 Reviewers are responsible for performing a thorough technical and administrative review of proposed documents, revisions, and cancellations to assure that they adequately address the subject matter, are technically accurate, and are in conformance with the requirements of this procedure and the references. Reviewers are responsible for assuring that a revision does not result in a deviation from regulatory requirements or commitments that were satisfied by the previous issue of the document. In addition, they are responsible for assuring that revisions to limited sections of a document do not result in conflicts with other sections that are not being revised.

3.3.2 An Independent Technical Reviewer (ITR) is responsible for verifying that the document is technically adequate and correct. In addition, Independent Technical Reviewers are responsible for maintaining their independence from the preparation of a document for which they serve as an ITR.

3.4 Project Radiation Safety Officer

The Project Radiation Safety Officer (RSO) is identified as a reviewer for all GRC Cyclotron Decommissioning Project documents and is responsible for ensuring radiological protection of workers, the public and the environment. In lieu of a Project Radiation Safety Officer, the NASA GRC Radiation Safety Officer may fulfil these responsibilities.

3.5 Supervisors and Task Managers

Supervisors and managers of tasks governed by procedures are responsible for assuring that only current approved revisions of documents are used for control of work activities, assuring that field activities are documented in accordance with this procedure and, that upon close out of Work Execution Packages, that required documentation is complete and accurately reflects the work performed.

3.6 Various Cyclotron Decommissioning Project Staff

Responsibilities associated with document control will be assigned as collateral duties to GRC Cyclotron Decommissioning Project staff. These persons will be responsible for document distribution, version control and associated record keeping. Alternately, the Project may utilize a dedicated document control administrator.

4.0 PROCEDURE

4.1 General Requirements

4.1.1 Instructions, procedures, and drawings shall be used to insure that activities of a type described in Appendix A, are performed in a manner that assures the protection of the workers, the public, and the environment from exposure to radiation and radioactive material, hazardous materials, and industrial health and safety hazards. They shall assure that the methods of controlling and performing work activities are consistent within all site working organizations and consistent with all applicable regulatory requirements. In addition, Work Execution Packages may be used to document and perform engineering design changes to the facility.

4.1.2 Instructions, procedures, plans, drawings, etc. will be complied with. When an unexpected situation occurs such that an instruction, procedure, plan, or drawing cannot be complied with as written, the work in progress shall be stopped, placed in a safe condition, and appropriate management informed of the situation. The activity will not be resumed until a revised instruction, procedure, plan, or drawing is approved and issued for implementation.

4.1.3 All individuals designated to sign a document as a reviewer or approver share in the originator's responsibility for the accuracy and adequacy of the final document. Accordingly, these individuals shall conduct their reviews in sufficient depth to assure that the final document meets the Project's high standards of quality.

4.1.4 When reviewing and concurring in a document revision that affects only limited portions of the document, sufficient review of the document in its entirety shall be performed to assure that the revisions do not have a negative impact or conflict with sections that are not revised. The reviewer/concurrence signature shall indicate concurrence in the document in its entirety.

4.1.5 Documents shall be typed in Microsoft™ WORD format so they are readily available electronically. Any readily available font may be used as suits the author's preference as long as the finished document presents a neat and professional appearance and is easy to read.

4.1.6 Documents shall be written and formatted in such a manner that they can be saved as a single Microsoft™ WORD file. An individual document shall not be stored in the form of multiple electronic files unless it is so large that it exceeds the storage capacity of the standard storage media available at the Project.

4.1.7 If a procedure prescribes forms intended for general recurring use, the forms may be reproduced in Microsoft™ WORD or EXCEL format as a stand-alone file without the procedure headers and footers.

4.1.8 Forms that are shown in a procedure as an "Example" may be modified as long as the content given is retained as a minimum.

4.2 Creation, Revision, Review, and Approval of a Cyclotron Decommissioning Project Plan or Procedure

4.2.1 When writing a new or revised plan or procedure, the originator shall determine the extent of any regulatory requirements or commitments that need to be imposed or revised in the written procedure and, as needed, will communicate with the organizations affected by the procedure to obtain any needed inputs for generating or revising the document.

4.2.2 Each new procedure shall have a unique number using the convention outlined in Appendix B. If revising an existing procedure, verify the correct revision number to use on the revised procedure. To differentiate those Procedures covering Cyclotron Decommissioning Project activities from other health physics procedures at GRC, the text "(CYC)" will be added to the end of the procedure number.

4.2.3 For those procedures serving as both GRC Health Physics Procedures and GRC Cyclotron Decommissioning Project Procedures, the content on the title page or other leading pages as well as page headers may vary somewhat from what is outlined in AD-01. For example, "Health Physics Procedure" may be stated instead of "Cyclotron Decommissioning Project."

4.2.4 Prepare the written procedure or revision using the following format:

4.2.4.1 The first four pages of a procedure will consist of the Procedure/Plan Title Page shown in Exhibit 1, the Routing and Approval Sheet shown in Exhibit 2, the Change/Cancellation Record shown in Exhibit 3, and the List of Effective Pages shown in Exhibit 4. These pages will be un-numbered and the standard forms for these pages are completed as described in the Exhibits to this procedure.

4.2.4.2 Organize the body of the procedure using the format shown in Appendix B of this procedure.

4.2.5 Plans and other programmatic documents are generally broader in scope and less detailed and specific than implementing procedures. They provide overall descriptions of the programs and general commitments that will be implemented through specific procedures. In general, to initiate a new or revised Plan or other programmatic document, follow the same steps as used for procedures in steps 4.2.1 through 4.2.3 of this procedure with the following additional guidance:

4.2.5.1 A Table of Contents may be inserted after List of Effective Pages. Number the Table of Contents pages with sequential lower case Roman Numerals (i.e., i, ii, iii, iv, etc.).

4.2.5.2 If practical, format the body of the document in a manner as close as possible to that specified for procedures. However, it is recognized that some Plans or Programmatic or Organizational documents may, by their very nature and content, not be conducive to that format. In such cases, organize the document in an outline or chapter format that is neat, logical, easy to read, and presents a professional appearance.

4.2.6 Project Procedures shall be concurred on and signed by at least the following personnel:

- Originator
- Independent Technical Reviewer (ITR)
- Project Radiation Safety Officer (RSO)
- NASA Cyclotron Decommissioning Project Manager (or designee)
- (ONLY For documents submitted to the NRC) NASA GRC RSO

4.2.7 Signature requirements to be met for Procedures.

4.2.7.1 The Originator and ITR shall both have the necessary knowledge and/or experience to develop and critically review documents being generated.

4.2.7.2 The Project RSO may serve as the ITR or the Originator

4.2.8 Project Plan review, concurrence and approval.

4.2.8.1 Original issue Project Plans and their revisions shall be reviewed and concurred in by the same individuals designated in step 4.2.6.

4.2.8.2 Some Project Plans may require concurrence and approval from other (i.e. non-Project) entities in accordance with established GRC policy and/or procedures (e.g. Safety and Health Division approval of the Project Health and Safety Plan, or HaSP, or a Fall Prevention Plan). In such cases, the NASA Cyclotron Decommissioning Project Manager shall specify the list of concurrence signatures required for the subject document.

4.2.8.3 Signature requirements for Project Plans shall, at a minimum, satisfy those described in step 4.2.7.

4.3 Creation, Revision, Review and Approval of a GRC Cyclotron Decommissioning Project Work Execution Package

4.3.1 An individual knowledgeable of the work to be performed shall prepare the Work Execution Package (WEP) or revision to an existing WEP.

4.3.2 Create a unique number for the WEP or a revision number for a revised WEP in accordance with Appendix C.

4.3.3 WEP originators shall familiarize themselves with the work area and the systems, components, and potential hazards that the area may contain. This familiarization shall also include a review, to the extent needed, of drawings, circuit diagrams and sketches that may provide information pertinent to preparing the WEP and in assessing the potential industrial and radiological safety hazards. It may be necessary to consult with field personnel, radiological controls staff, industrial safety and health staff and other site staff familiar with the area and familiar with the regulatory aspects that may need to be incorporated into the WEP.

4.3.4 Prepare the written WEP using the following format:

4.3.4.1 The first page will consist of the GRC Cyclotron Decommissioning Project Work Execution Package Cover Sheet shown in Exhibit 5. This page will be unnumbered, completed as described in the Exhibit, and listed in the List of Effective Pages

(LOEP) as "Cover Page", and the listing shall show the current revision number.

4.3.4.2 The second and third pages will be the GRC Cyclotron Decommissioning Project Change/Cancellation Record shown in Exhibit 3, and the LOEP shown in Exhibit 4. These pages will be un-numbered and the standard forms for these pages are completed as described in the Exhibits to this procedure.

4.3.4.3 Organize the body of the WEP using the format and guidance shown in Appendix C of this procedure.

4.3.5 Upon completion of the review and comment on the draft, the originator shall prepare the final document for formal review.

4.3.6 Project WEPs shall be concurred on and signed by at least the following personnel:

- Originator
- Independent Technical Reviewer (ITR)
- Project Radiation Safety Officer (RSO)
- NASA Cyclotron Decommissioning Project Manager (or designee)

4.3.7 Signature requirements to be met for WEPs.

4.3.7.1 The Originator and ITR shall both have the necessary knowledge and/or experience to develop and critically review documents being generated. The independent technical review of the WEP is the responsibility of the organization preparing the subject document.

4.3.7.2 The Project RSO may serve as the ITR or Originator

4.3.7.3 Some Project WEPs may require concurrence and approval from other entities (i.e. non-Project) in accordance with established GRC policy and/or procedures. In such cases, the NASA Cyclotron Decommissioning Project Manager shall specify the list of concurrence signatures required for the subject document

4.4 Final Document Concurrence and Distribution

4.4.1 When the Plan, Procedure, or WEP has been reviewed and approved, the NASA Cyclotron Decommissioning Project Manager (or designee) shall sign and date the document, and assign an effective date. This copy with the original signatures will become the Hard Copy Original and will be kept on

file. A read-only electronic version of this signed document may be maintained in an electronic document management tool, such as the NASA GRC eRoom Site or similar project management website.

4.5 Implementation and Closeout of a Work Execution Package

4.5.1 Work specified in a WEP may begin on the effective date specified by the Cyclotron Decommissioning Project Manager (or designee).

4.5.2 On each day that activities prescribed by a WEP are performed, a GRC Cyclotron Decommissioning Project Work Execution Package Daily Activity Plan (Exhibit 6) will be completed by field supervisors and filed with the Addenda section of the WEP. This form will document the daily activities performed under the WEP and will document the performance of a pre-work briefing.

4.5.3 Upon completion of the work prescribed by the WEP or upon issue of a revised WEP, the documentation shall be closed as follows:

4.5.3.1 Field supervisors shall assure that all field generated documents, including the Daily Activities Plan are filed with the Addenda section of the WEP Hard Copy Original.

4.5.3.2 If the WEP is being superseded by a revision, the supervisor shall annotate the cover page stating that the WEP has been superseded by a new revision.

4.5.3.3 The package shall then be submitted to the Responsible Manager (or designee) who shall review and sign the Close-Out Approval section of the original WEP.

4.6 Cancellation of Procedures and Plans

4.6.1 Cancellation of a procedure or plan is considered to be a revision and requires sufficient depth of review to confirm that the requirements and controls prescribed by the document are either no longer required, or have been adequately incorporated into a different document.

4.6.2 Preparation of a cancellation shall be as follows:

4.6.2.1 The originator prepares the first three pages (i.e.: Title Page, Routing and Approval Sheet, and Change/Cancellation Record) of a procedure or plan as described in step 4.2.3.1 of this procedure. In the Revision Number section of these pages, indicate "CANCELLATION".

4.6.2.2 On the GRC Cyclotron Decommissioning Project Change/Cancellation Record (Exhibit 3) enter "Procedure/Plan Cancelled" in the next line of the form with a description of the reason for cancellation.

4.6.3 Route the cancellation for review and approval in the same manner as a revision.

5.0 APPENDICES AND EXHIBITS

5.1 Appendix A, "Guidance on Activities Requiring Written Procedures"

5.2 Appendix B, "Procedure Format and Content"

5.3 Appendix C, "Work Execution Package Format and Content"

5.4 Exhibit 1, "GRC Cyclotron Decommissioning Project Procedure/Plan Title Page"

5.5 Exhibit 2, "GRC Cyclotron Decommissioning Project Routing and Approval Sheet"

5.6 Exhibit 3, "GRC Cyclotron Decommissioning Project Change/Cancellation Record"

5.7 Exhibit 4, "List of Effective Pages"

5.8 Exhibit 5, "GRC Cyclotron Decommissioning Project Work Execution Package Cover Sheet"

5.9 Exhibit 6, "GRC Cyclotron Decommissioning Project Work Execution Package Daily Activity Plan"

5.10 Exhibit 7, "GRC Cyclotron Decommissioning Project Document Control Log" (Example)

APPENDIX A
Guidance on Activities Requiring Written Procedures

The following activities shall be performed in accordance with written instructions, procedures, or drawings:

1. Routine maintenance on major components or systems that could have an effect on radiation safety.
2. Personnel radiation protection consistent with applicable regulations.

   This includes performance and documentation of surveys, sampling, and personnel monitoring. It includes implementation of an ALARA program, development of RWP's, dosimetry control, dose assessment, and control of postings.
3. Administrative controls for maintenance and for the conduct of activities that could affect facility radiation safety.

   This includes all administrative controls related to the performance of decommissioning activities, and the generation and retention of records required by regulations applicable to the project or to the NRC License.
4. Shipping and receipt of radioactive material.

   This includes any special procedures for Cyclotron Decommissioning Project activities which fall outside the scope of existing Center processes for RAM shipment or receipt.
5. Waste Management

   This includes the collection, isolation, sampling, analysis, characterization, storage, handling, packaging, and preparation for shipment, transfer, or disposal of material containing radioactive material. In addition, it includes the specification of containers, purchase, receipt, inspection, and control of containers that will be used for the control of radioactive material.
6. Environmental Protection Management

   This includes procedures for the implementation of the Environmental Management Plan, Storm Water Pollution Prevention Plan, Environmental Media Sampling and Analysis Plan, and for the control, handling, and processing of Hazardous Waste or Mixed Waste, as applicable. Alternatively, other Center processes/protocols may be utilized/implanted to satisfy these requirements.
7. Design, performance, review, and quality control of radiological survey and sampling performed in support of Characterization and Final Status Survey.

APPENDIX B
Procedure Format and Content

The pages used for the body, appendices, and attachments of the procedures shall have a header similar to the following:

NASA GRC Cyclotron Decommissioning Project	**Title: -1-**	
	Document Number: -2a- -2b-	**Revision Number: -3-**

-1- : Enter a title for the procedure. The title should be brief but should effectively reflect the procedure's objectives.

-2a-: Enter a unique number for the procedure. For example, procedures that are within the Administrative system are numbered AD-01, 02, 03, etc. Use the following convention, or similar, for numbering procedures:

- AD: Administrative Systems
- CP: Radiological Characterization and Final Status Survey
- EM: Environmental Management Processes
- HS: Industrial Health and Safety/Industrial Hygiene
- RP: Radiation Protection Activities
- QA: Quality Assurance Programs and QA Related Activities
- WM: Waste Management Operations

-2b-: Enter the text "(CYC)" to designate that the procedure is associated with the Cyclotron Decommissioning Project.

-3-: Enter a revision number. When a new procedure is issued, all pages will be indicated as "Revision 0". When updated, the revision number will apply to the document in its entirety.

Enter the required procedure/plan information on the GRC Cyclotron Decommissioning Project Document Control Log (Exhibit 7).

All pages of the body will have a footer that provides a sequential number for all pages, beginning with page 1 for the first page of the body.

Organize the body of the procedure in a numbered outline format with the following sections as a minimum:

APPENDIX B
Procedure Format and Content

1.0 INTRODUCTION

1.1 **Purpose** – provide a procedure description and the objectives that are expected to be accomplished.

1.2 **Scope** – provide statements that describe the conditions under which the requirements and provisions of the procedure apply and the extent to which they apply.

2.0 REFERENCES

2.1 **Applicable Documents** – In sub-elements to this heading, list reference documents to which reference is actually made in the document. Note that this section is not intended to be a bibliography of all documents that were researched in the preparation of the procedure. It should only list those documents that are actually referred to in the text of the procedure.

2.2 **Records** – In sub-elements to this heading, list the project records that this procedure creates or affects, and a brief description of the disposition of those records. If there are no records established or affected by the procedure, this section may be omitted and the following sections renumbered accordingly.

2.3 **Definitions** – In sub-elements to this heading, define significant words or phrases that appear in the procedure for which the originator desires to apply a specific definition. Commonly used terms and phrases that are already clearly defined in Regulations, or other higher tier documents such as the Decommissioning Plan, do not need to be re-listed in this section unless this procedure intends to apply a more specific definition than those previously given.

3.0 RESPONSIBILITIES

In this section provide a sub-element for each organization and/or position with specific responsibilities related to completion of actions contained in or specified by the procedure.

4.0 PROCEDURE

4.1 Section four is the beginning of the body of the procedure. This section and subsequent sequentially numbered sections shall be given appropriate header titles and provide the step by step elements needed to clearly specify the directions to successfully accomplish the objectives of the procedure. The first main element (section 4.1) will generally be a list of general requirements, or precautions and limitations, or prerequisites as appropriate. It may also be the first logical section of a procedure containing several subsequently numbered sections.

APPENDIX B
Procedure Format and Content

4.2 Use an outline number format for section numbering, for example:

4.0 PROCEDURE

X.1 **Sub Element**

X.1.1 Sub-sub element

X.1.1.1 Further sub-elements

4.3 If appropriate to the subject matter, the body of the procedure may include a BACKGROUND section in which the overall process, the reasons for the process being developed, or a summary of the technical or regulatory issues related to the process may be discussed.

4.4 Procedural steps or elements should provide sufficient guidance such that personnel can effectively and efficiently follow the procedure. A procedure should contain sufficient detail for an individual to perform the required functions without direct supervision, but need not provide a complete description of the process or system. The level of detail should be commensurate with the training and qualifications of the individuals who will normally perform the function.

4.5 Avoid procedural steps and sequences that unnecessarily constrain or complicate conduct of the procedure. Provide flexibility to the extent practical while maintaining the intent and integrity of the procedural controls.

4.6 Use "NOTES" within a procedure when it is desired to reinforce the user's understanding of a particular statement or to provide explanation of the step. Do not include executable steps or actions within a "NOTE".

4.7 Use "CAUTION" notes immediately prior to steps where the user should be alerted to a specific potential hazard or where the user should be alerted to the need to take a precautionary measure before, during, or immediately following the performance of the steps. Do not include executable steps or actions within a "CAUTION".

4.8 Ensure that procedural elements do not conflict with other existing procedures, plans, or programs.

4.9 As a general rule, avoid long sentences, complex or confusing punctuation, slang, jargon, and incorporation of multiple steps or actions into a single procedure step.

4.10 In general, incorporate the requirements of other procedures, plans, and programs by reference rather than by direct insertion into the text. This will minimize the need to revise the procedure if the reference is changed.

APPENDIX B
Procedure Format and Content

5.0 APPENDICES AND EXHIBITS

5.1 The last section of the body of the procedure will be titled "Appendices, Attachments, Exhibits, etc." as appropriate and will follow with subsequent sub-paragraphs that list the titles of the appropriate Appendices, Attachments, Exhibits, etc., as appropriate. For example:

5.0 APPENDICES AND EXHIBITS

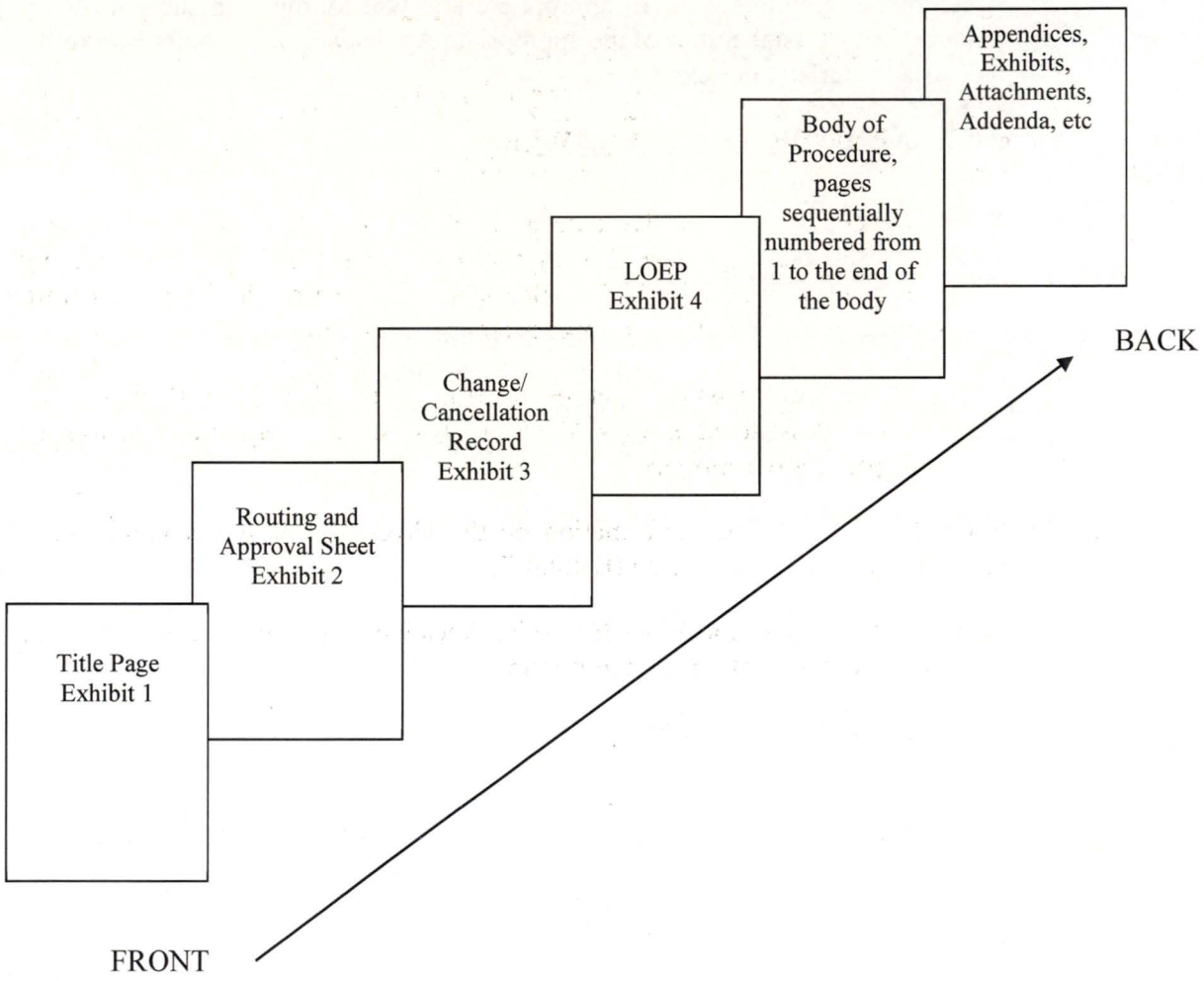
X.1 Appendix A, "Title"

X.2 Exhibit 1, "Title"

Attachments, Appendices, Forms, Addenda, Exhibits, etc., shall have a header that in addition to the information contained in the body header will have a centered title indicating the Appendix, Attachment, Exhibit etc., number and the title of the Appendix, Attachment, etc. The bottom of the page will contain a footer with the page number formatted as "Appendix (or Attachment, etc.) #, page x of x", with the first page numbered as page 1 and subsequent pages sequentially numbered.

APPENDIX B
Procedure Format and Content

The final completed procedure will be compiled as shown:



APPENDIX C
Work Execution Package Format and Content

1.0 The pages used for the body of the Work Execution Packages shall have a header similar to the following:

GRC Cyclotron Decommissioning Project Work Execution Package	
Work Execution Package Number: WEP-_____-_____ -1-	**Revision No. -2-**

-1- : Enter the Work Execution Package Number. Work Execution Packages are numbered using the convention WEP-yy-xxx, where "yy" is the last two digits of the calendar year in which the Work Execution Package is initiated, and xxx is a sequential number.

-2-: Enter the revision number of the Work Execution Package. The original issue of a new WEP is Rev 0. Subsequent revisions are sequentially numbered.

Enter the required WEP information on the GRC Cyclotron Decommissioning Project Document Control Log (Exhibit 7).

2.0 Organize the body of the Work Execution Package in a numbered outline format with the following sections as a minimum:

1.0 TASK DESCRIPTION

Provide a brief description of the tasks to be performed, the task objectives, and the intended end point or task outcome. Use additional outline formatted subparagraphs as needed.

2.0 SPECIAL REQUIREMENTS

This section will describe the requirements specific to the Work Execution Package that must be imposed to assure the safe performance of the planned activity. This section will be broken down into the following sub-elements:

2.1 Special Equipment, Materials, and Training

In this section, provide a listing or description of special tools, equipment, materials, and training that will be needed to perform the planned tasks. This section does not need to be a detailed list of every possible item needed for the task, rather it should be written with the assumption that normal common hand tools and accessories are available and that all individuals assigned to perform the tasks have

received relevant training. It should describe the need for special tools or material handling equipment and specialized training such as "Qualified Crane Operator", "HAZWOPER", asbestos worker training, lead worker training, etc., that will be required to perform the task and exceed the normally expected training and qualification levels of the field workers. Use additional outline formatted subparagraphs as needed.

2.2 Permits and Special Controls Required

In this section, list all of the permits that will be required to perform the planned activity. These would include Radiation Work Permit, Hot Work Permit, Confined Space Permit, Excavation Permit, or any other facility permits that may be needed. The need for permits is determined by the evaluation of the proposed work activity performed in the job specific Job Hazard Analysis (JHA) which will be included in the Work Execution Package as Appendix A. Any special controls required will be determined by the JHA. Use additional outline formatted subparagraphs as needed.

NOTE: This section does not need to identify the permits by specific permit number, as the permits may be prepared after approval of the WEP. It is intended as a place to identify the fact that a specific type of permit will be required to perform the planned work activities.

3.0 REFERENCES

3.1 Reference Documents

In sub-elements to this heading, list documents to which reference is actually made in the WEP. Note that this section is not intended to be a bibliography of all documents that were researched in the preparation of the procedure. It should only list those documents that are actually referred to in the text of the WEP. If there are no references, state "NONE" in this section.

3.2 Definitions

In sub-elements to this heading, define significant words or phrases that appear in the procedure for which the originator desires to apply a specific definition. Commonly used terms and phrases that are already clearly defined in Regulations, or other higher tier documents such as the Decommissioning Plan, do not need to be re-listed in this section unless this procedure intends to apply a more specific definition than those previously given. If there are no terms that require specific definitions, state "NONE" in this section.

APPENDIX C
Work Execution Package Format and Content

4.0 PREREQUISITES, PRECAUTIONS, AND LIMITATIONS

Prerequisites are any actions that must be completed and verified completed before the Work Execution Package can be used. These are generally actions that are performed by some other instruction or procedure, or are pre-existing conditions that must exist. If an initial set of conditions must be established by this procedure, they should in general be established by initial procedural steps rather than be listed as prerequisites. In this section provide a sub-element for each prerequisite that must be satisfied.

Precautions and Limitations are important measures which are used to protect personnel or equipment, to avoid an abnormal or emergency situation, or to place specific limitations on the processes used or scope of work being performed. In addition to being listed here, they should also appear in a blocked-in cautionary note immediately prior to the specific step where needed to alert the user of a potential hazard.

3.0 Organize the work performance steps beginning with an appropriately titled section 5.0 and continue with as many outline formatted subparagraphs as needed to clearly and logically prescribe the steps need to perform the work as shown in the example below:

5.0 First main element

5.1 Sub-element

5.1.1 Sub-sub-element

6.0 Second main element

6.1 Sub-element

6.1.1 Sub-sub-element

Continue with outline numbered sections as needed to provide the step by step elements needed to clearly specify the directions to successfully accomplish the objectives of the procedure. The following is general guidance on the content and nature of the steps to be included in a WEP:

- Elements of the Work Execution Package should provide sufficient guidance such that personnel can effectively and efficiently follow and implement the steps. A Work Execution Package should contain sufficient detail for an individual to perform the required functions without direct supervision, but need not provide a complete description of the process or system. The level of

APPENDIX C
Work Execution Package Format and Content

detail should be commensurate with the training and qualifications of the individuals who will normally perform the function.

- Avoid Work Execution Package steps and sequences that unnecessarily constrain or complicate conduct of the procedure. Provide flexibility to the extent practical while maintaining the intent and integrity of the procedural controls.
- The Work Execution Package steps shall be written with the assumption that they will be performed in the sequence in which they appear. If work is not 'sequence sensitive', the Work Execution Package shall clearly state which steps do not need to be performed in the order in which they appear.
- Use "NOTES" within a Work Execution Package when it is desired to reinforce the user's understanding of a particular statement or to provide explanation of the step. Do not include executable steps or actions within a "NOTE".
- Use "CAUTION" notes immediately prior to steps where there is a need to alert the user to a specific potential hazard or to the need to take a precautionary measure before, during, or immediately following the performance of the steps. Do not include executable steps or actions within a "CAUTION".
- Ensure that procedural elements do not conflict with other existing procedures, plans, or programs.
- As a general rule, avoid long sentences, complex or confusing punctuation, slang, jargon, and incorporation of multiple steps or actions into a single procedure step.
- In general, incorporate the requirements of other project approved procedures, plans, and programs by reference rather than by direct insertion into the text. This will minimize the need to revise the procedure if the reference is changed.
- When executable steps in a Work Execution Package are to be performed in accordance with manufacturer's published technical manuals, it is acceptable to either incorporate the manual procedures by reference or include the applicable portion of the manual in the Work Execution Package as an Attachment.
- If executable steps in a Work Execution Package are to be performed in accordance with contractor or vendor prepared procedures that are not part of a published technical manual, it is acceptable and encouraged to include the document or sections of the document in the Work Execution Package as an Attachment, rather than rewrite the document into the body of the Work Execution Package.

APPENDIX C
Work Execution Package Format and Content

- If steps of a Work Execution Package require lifting and handling operations where specific use of lift plans, rigging sketches, etc. are needed, they may be included in the WEP as Attachments and review and approval obtained as part of the WEP review and approval process. However, there may also be situations where the detailed lifting plans and sketches cannot be prepared during the WEP development process due to the need to obtain field data and information prior to their preparation. In these situations, and situations where lift documentation was not prepared as an Attachment during WEP preparation, the steps of the WEP should be worded in such a manner that these plans and sketches are prepared, reviewed, and approved in accordance with applicable lifting and handling procedure requirements prior to performing the lifting steps. The lifting documents shall then be inserted in the WEP Addenda as Field Generated documents.

4.0 The last section of the body of the Work Execution Package will be a listing of the Appendices, Attachments, and Addenda, as appropriate, per the following example:

X.0 APPENDICES, ATTACHMENTS, AND ADDENDA

X.1 Appendix X, "Title"

X.2 Attachment X, "Title"

X.3 Addendum X, "Title"

5.0 Following the body of the WEP will be the Appendices. Appendix A of the Work Execution Package will be a job-specific Job Hazard Analysis (JHA). Any specific precautions and limitations identified by the JHA shall be incorporated as Work Execution Package line items in the appropriate section of the body of the Work Execution Package. The pages of the JHA will be marked at the top of each page with a header similar to the following:

Appendix A, Job Hazard Analysis

Work Execution Package WEP-_____-_____

The bottom of each page shall be numbered page x of y, where 'x' is a sequential number beginning with 1, and 'y' is the total number of pages to the JHA. Appendix A pages shall be listed in the WEP LOEP as Appendix A, page x, etc.

5.1 Additional Appendices may be added as needed. In general, Appendices should be used to incorporate items such as safety analysis, structural evaluations, calculations, or other types of technical or regulatory required analysis that may be needed to support the work

APPENDIX C
Work Execution Package Format and Content

activities described in the WEP. Using Appendices in this manner enables the WEP to be used as both an installation procedure and an engineering design package if needed.

6.0 Attachments will be added to incorporate drawings, sketches, layout diagrams, surveys, or vendor or contractor procedures needed to support the planned work. A cover sheet will be included at the beginning of each Attachment giving the Work Execution Package number, the Attachment number, and a title for the Attachment. This cover sheet will be unnumbered and shown in the LOEP as "Attachment x, Cover Page". Pages after the Attachment cover page will be numbered or identified in any convenient format that allows listing of each uniquely identified page in the LOEP and is conducive to performing page checks of the Work Execution Package to verify its completeness.

7.0 Addenda will be used to insert field generated documents into the WEP. In general, Addenda will be used where it is necessary to record data or information collected in the field during performance of the planned work. The first Addendum will be as follows:

- Addendum 1 of the WEP will be a Work Execution Package Daily Activities Plan. The Work Execution Package will have a single copy of the Daily Activities Plan with only the identifying information filled in included during the review and approval of the WEP. It will be shown on the WEP LOEP as Addendum 1. Subsequent pages and insertions will not be listed in the LOEP. The Daily Activity Plan, as shown in Exhibit 6, will be filled in by the appropriate job supervisor each day that work is performed under the control of the WEP. The Daily Activity Plan provides a check list to assure that appropriate permits are in effect each day prior to start of work, provides an input for the daily pre-job briefing of the work crews, and a means for verifying that the JHA and all necessary procedures are up to date. In addition, it provides a daily journal of the work accomplished and a record of pre-job briefing attendance. Each day that work is performed under the WEP, an additional Daily Activities Plan will be completed.
- If additional Addenda are needed to record field data or to insert lift plans or rigging sketches, they shall be numbered sequentially and listed in the LOEP as Addendum 'x', where 'x' is a sequential number.

8.0 The final completed Work Execution Package will be compiled as shown on the following page:

APPENDIX C
Work Execution Package Format and Content

The final completed WEP will be compiled as shown:

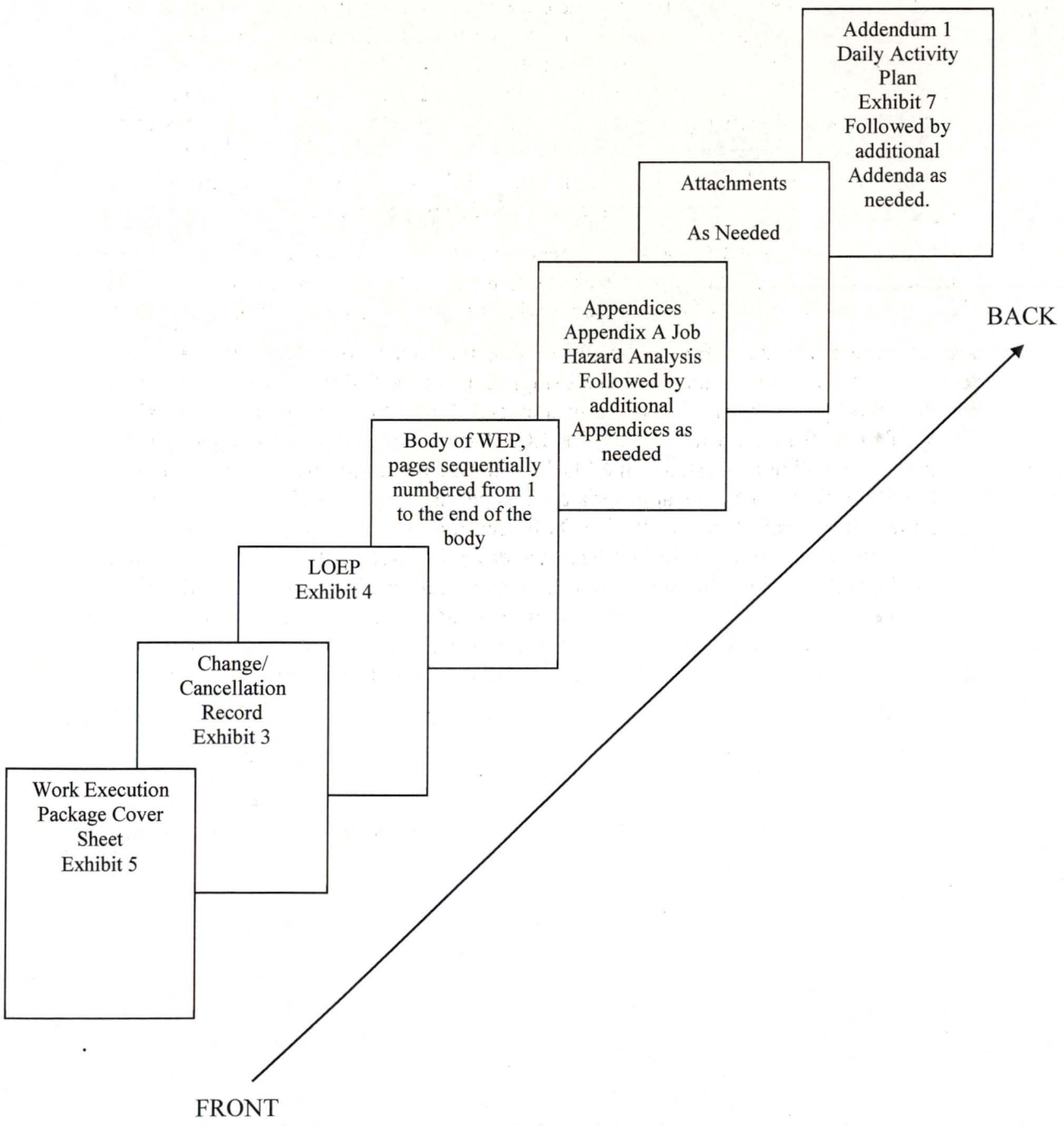


Exhibit 1

GRC Cyclotron Decommissioning Project - Procedure/Plan Title Page

NASA Glenn Research Center
Cyclotron Decommissioning Project

- 1 -

- 2 -

- 3 -

- 4 -

Exhibit 1

GRC Cyclotron Decommissioning Project - Procedure/Plan Title Page

- 1 -: Enter the title of the document. A Times New Roman 20 pt bold font is recommended.

-2-: Enter the procedure/document number. A Times New Roman 16 pt font is recommended.

- 3 -: Enter the revision number of the document. A Times New Roman 16 pt font is recommended.

- 4 -: (Optional) Revision date. A Times New Roman 16 pt font is recommended.

Exhibit 2

NASA GRC Cyclotron Decommissioning Project - Routing and Approval Sheet

NASA GRC CYCLOTRON DECOMMISSIONING PROJECT ROUTING AND APPROVAL SHEET

Document Title: - 1 -

Document Number: - 2 - **Revision Number:** - 3 -

ROUTING

	Signature	Date
Originator	- 4 -	
Review and Concurrence:		
Independent Technical Reviewer	- 5 -	
Project Radiation Safety Officer	- 6 -	
NASA Cyclotron Decommissioning Project Manager	- 7 -	
	- 5 -	
	- 5 -	

IMPLEMENTING APPROVAL: - 7 - _____ _____

Signature **Date**

EFFECTIVE DATE: - 8 - _____

Exhibit 2

NASA GRC Cyclotron Decommissioning Project - Routing and Approval Sheet

- 1 -: Enter the title of the document.

- 2 -: Enter the document number.

- 3 -: Enter the revision number of the document. For a new document this will be revision 0.

- 4 -: The procedure originator signs and dates in this block when all comments from the review process have been resolved, and the document is submitted for final approval.

- 5 -: The ITR will sign and date the appropriate block when they are ready to concur with the final document. Similarly, other reviews identified on the Routing and Approval Sheet will also sign and date as needed.

- 6 -: The Project Radiation Safety Officer signs and dates signifying approval of the final document.

- 7 -: The NASA Cyclotron Decommissioning Project Manager (or designee) signs and dates signifying that all reviews are complete and the document is ready for distribution and implementation on the date specified in the following.

- 8 -: The NASA Cyclotron Decommissioning Project Manager (or designee) enters the effective date by which the document is to be implemented. On the specified date, compliance with the document is mandatory and all prior revisions, if any, are cancelled.

Exhibit 3

NASA GRC Cyclotron Decommissioning Project - Change/Cancellation Record

NASA GRC CYCLOTRON DECOMMISSIONING PROJECT CHANGE/CANCELLATION RECORD		
DOCUMENT TITLE: - 1 -	**DOCUMENT NO:** - 2 -	**REVISION NO:** - 3 -
Revision 0: Initial issue of Document - 4 -		
Revision 1: - 5 -		

Exhibit 3

NASA GRC Cyclotron Decommissioning Project - Change/Cancellation Record

- 1 -: Enter the title of the document.

- 2 -: Enter the document number.

- 3 -: Enter the document revision number. For a new document this will be revision 0.

- 4 -: In the first line of the form, enter "Revision 0: Initial Issue of Document"

- 5 -: In subsequent lines of the table enter the subsequent revisions. This will be a historical list of all revisions to the procedure. Accordingly, as subsequent revisions are issued, the record of prior revisions is not deleted; rather, additional table lines are added as needed to keep a list of all prior revisions. After entering the latest revision number, give a brief description of the revision. If a revision reissues the entire document, state that the revision revised the document in its entirety and describe the basic reasons for the revision. If only selected pages of the document are revised, list the page numbers that were changed.

Exhibit 4
List of Effective Pages (LOEP)

LIST OF EFFECTIVE PAGES

DOCUMENT NO: - 1 - **REVISION NO.:** - 2 -

Page No.	Revision Level	Page No.	Revision Level	Page No.	Revision Level
- 3 -	- 5 -				
- 4 -					

Exhibit 4
List of Effective Pages (LOEP)

- 1 -: Enter the Procedure, Work Execution Package, or document number or the title if the document is not numbered.

- 2 -: Enter the current revision number of the document.

- 3 -: The first four entries will always be the Cover Page, Routing Page, Change Record, and LOEP.

- 4 -: Enter the number of the remaining pages of the document. The pages in the body of the document are sequentially numbered as 1 through the end. Appendices, Attachments, Addenda, Exhibits, etc. will be listed with an indication of the Appendix etc. number and the page number within the Appendix. For Example:

  Pages 1 thru nn
  APP A, Pg 1
  APP A, Pg 2
  EXH 1, Pg 1
  ATT 1, Pg 1
  Etc.

  It is important to be sure that every effective page of the document is included in the LOEP, since it serves as a tool to page check a document in use to assure that the document in use is complete and current.

- 5 -: List the current revision number for the page in the preceding column.

Exhibit 5

GRC Cyclotron Decommissioning Project Work Execution Package Cover Sheet

NASA GRC Cyclotron Decommissioning Project Work Execution Package

Work Execution Package Title

- 1 -

WEP Number - 2 - WEP-_____-_____	**Revision #** - 3 -	**Effective Date** - 4 -

DOCUMENT CONTROL STAMP

- 5 -

Title	Signature	Date
Originator	- 6 -	
Independent Technical Reviewer		
Supervisory Review		
Project Radiation Safety Officer		
IMPLEMENTATION APPROVAL		
NASA Cyclotron Decommissioning Project Manager	- 7 -	
CLOSE OUT APPROVAL		
Responsible Manager	- 8 -	

Exhibit 5

GRC Cyclotron Decommissioning Project Work Execution Package Cover Sheet

- 1 - : Enter a concise but descriptive title for the Work Execution Package.

- 2 - : Enter the WEP number using the guidance provided in Appendix C.

- 3 - : Enter the revision number of the Work Execution Package. An initial issue of a Work Execution Package will be Rev. 0, with subsequent revisions sequentially numbered.

- 4 - : The effective date is entered by the Implementing Approval after signing the approval block.

- 5 - : This space is for imprinting the document control stamp for Field Copies.

- 6 - : Enter a concise but descriptive title for the Work Execution Package.

- 7 - : Implementation Approval

- 8 - : Close Out Approval

Exhibit 6

NASA GRC Cyclotron Decommissioning Project - Work Execution Package Daily Activity Plan

ADDENDUM 1
DAILY ACTIVITY PLAN

Date:		**Reference Permits**	
WEP and Rev. #		**RWP #**	
WEP Name		**Confined Space Permit #**	
Building #		**Hot Work Permit #**	
Area/Location		**Critical Lift Plan #**	
Field Supervisor		**Excavations (Dig) #**	
		Other	

Safety Topic:

Planned Activities:

Safety Notes/Instructions:

Daily Check List

Reviewed	**Yes**	**N/A**	**Initials**	**Daily Hazards** (Check all that apply.)		
Job Hazard Analysis				☐ Vision	☐ Hazardous Energy	☐ Fire
Work Instructions				☐ Noise	☐ Hand	☐ Access
Referenced Permits				☐ Head	☐ Slip, Trip, Fall	☐ Electrical
RWP and Postings				☐ Foot	☐ Material Handling	☐ Communication
Implementing Procedures				☐ Face	☐ Thermal	☐ Ergonomic
Other (specify)				☐ Respiratory	☐ Confined Space	☐ Interface
				☐ Lead	☐ Rescue	☐ Radiological
				☐ Asbestos	☐ Chemical Exposure	☐ Other

Review the current radiological surveys associated with the RWP's for this job and assure that the radiological conditions are discussed in the pre-job brief. ☐

Exhibit 6

GRC Cyclotron Decommissioning Project Work Execution Package Daily Activity Plan

DAILY ACTIVITY REPORT		
WEP #		**Date**
WEP Name:		
Work Completed This Shift:		

Exhibit 6

GRC Cyclotron Decommissioning Project Work Execution Package Daily Activity Plan

WEP Pre-Job Briefing Attendance Sheet Please Circle: Initial or Daily					
WEP NUMBER:		Rev. #		Conducted By:	
WEP/WEP SUPPLEMENT NAME:					

PRINT NAME	SIGNATURE	I.D. NUMBER	DATE

Exhibit 7

NASA GRC Cyclotron Decommissioning Project - Document Control Log (Example)

Document Name/Type	Document Number	Revision Number	Date Implemented	Date Cancelled	Notes/Comments