Program Assessment Rating Tool Performance Measures

Advanced Scientific Computing Research

Long Term Measures

- By 2015, demonstrate progress toward developing the mathematics, algorithms, and software that enable effective scientifically critical models of complex systems, including highly nonlinear or uncertain phenomena, or processes that interact on vastly different scales or contain both discrete and continuous elements.
    - Definition of "Successful" – The mathematics for effective modeling of complex systems is developed. Algorithms implementing all these mathematical techniques are developed. The most promising algorithms have been selected, and software deploying these algorithms has been created and disseminated.
    - Definition of "Minimally Effective" – The mathematics for effective modeling of complex systems is developed. Algorithms implementing several of the mathematical techniques are developed.
    - How will progress be measured? – Expert Review every three years will rate progress as "Excellent", "Minimally Effective" or "Insufficient".

- By 2015, demonstrate progress toward developing, through the Genomes to Life partnership with the Biological and Environmental Research program, the computational science capability to model a complete microbe and a simple microbial community.
    - Definition of "Successful" – In partnership with BER, develop a computational model that accurately describes the potential of a microbial community to clean up waste, sequester carbon, or produce hydrogen, validated experimentally by the use or reengineering of that community based on model predictions.
    - Definition of "Minimally Effective" – In partnership with BER, develop a computational model that accurately describes the potential of a microbial community to clean up waste, sequester carbon, or produce hydrogen, validated by its consistency with available data.
    - How will progress be measured? – Expert Review every three years will rate progress as "Excellent", "Minimally Effective" or "Insufficient".

Annual Measures

- Focus usage of the primary supercomputer at the National Energy Research Scientific Computing Center (NERSC) on capability computing. Percentage of

the computing time used that is accounted for by computations that require at least 1/8 of the total resource.

- How will progress be measured? – Progress will be tracked quarterly through the Department of Energy's tracking system –Joule. Results will be reported in the Department's Performance and Accountability report that is published soon after the end of each fiscal year.
- Targets
  - 2003 – - 36%
  - 2004 – 50%
  - 2005 – 50%

- Maintain Procurement Baselines. Percentages within (1) original baseline cost for completed procurements of major computer systems or network services, and (2) original performance baseline versus integrated performance over the life of the contracts.
  - How will progress be measured? – Progress will be tracked quarterly through the Department of Energy's tracking system –Joule. Results will be reported in the Department's Performance and Accountability report that is published soon after the end of each fiscal year.
  - Targets
    - 2002 – <10%, 10% 0%, 0%
    - 2003 – <10%, 10% 0%, -1%
    - 2004 – <10%, 10%
    - 2005 – <10%, 10%

- Improve Computational Science Capabilities. Average annual percentage increase in the computational effectiveness (either by simulating the same problem in less time or simulating a larger problem in the same time) of a subset of application codes within the Scientific Discovery through Advanced Computing (SciDAC) effort. *(Efficiency measure)*
  - How will progress be measured? – Progress will be tracked quarterly through the Department of Energy's tracking system –Joule. Results will be reported in the Department's Performance and Accountability report that is published soon after the end of each fiscal year.
  - Targets
    - 2002 – baseline performance year
    - 2003 – >10% 3,181% *(Note that the improvements in effectiveness reported here are larger than projected improvements in the outyears due to the fact that SciDAC has already inserted state of the art mathematics into the applications. Future improvements in efficiency are unlikely to be this dramatic. Further information in the codes included in this measure can be provided.)*
    - 2004 – >50%
    - 2005 – >50%

Basic Energy Sciences

Long Term Measures

- By 2015, demonstrate progress in designing, modeling, fabricating, characterizing, analyzing, assembling, and using a variety of new materials and structures, including metals, alloys, ceramics, polymers, biomaterials and more – particularly at the nanoscale – for energy-related applications.
    - Definition of "Success" – BES-supported research leads to important discoveries that impact the course of others' research; new knowledge and techniques, both expected and unexpected, within and across traditional disciplinary boundaries; and high-potential links across these boundaries.
    - Definition of "Minimally Effective" – BES-supported research leads to a steady stream of outputs of good quality.
    - How will progress be measured? – Expert Review every three years will rate progress as "Excellent", "Minimally Effective" or "Insufficient".
- By 2015, demonstrate progress in understanding, modeling, and controlling chemical reactivity and energy transfer processes in the gas phase, in solutions, at interfaces, and on surfaces for energy-related applications, employing lessons from inorganic, organic, self-assembling, and biological systems.
    - Definition of "Success" - BES-supported research leads to important discoveries that impact the course of others' research; new knowledge and techniques, both expected and unexpected, within and across traditional disciplinary boundaries; and high-potential links across these boundaries.
    - Definition of "Minimally Effective" **-** BES-supported research leads to a steady stream of outputs of good quality.
    - How will progress be measured? - Expert Review every three years will rate progress as "Excellent", "Minimally Effective" or "Insufficient".

- By 2015, develop new concepts and improving existing methods for solar energy conversion and other major energy research needs identified in the 2003 Basic Energy Sciences Advisory Committee workshop report, *Basic Research Needs to Assure a Secure Energy Future*.
    - Definition of "Success" - BES-supported research leads to important discoveries that are rapidly and readily available and feed, as appropriate, into use or projected use by the Department's technology offices, by other federal agencies, and/or by the private sector. There is evidence of substantive interactions with the Department's technology offices in most BES program areas.
    - Definition of "Minimally effective" - BES-supported research leads to a steady stream of outputs of good quality that show the potential to impact energy research.

- How will progress be measured? - Expert Review every three years will rate progress as "Excellent", "Minimally Effective" or "Insufficient".

- By 2015, demonstrate progress in conceiving, designing, fabricating, and using new instruments to characterize and ultimately control materials.
  - Definition of "Success" - BES-supported research leads to new concepts and designs for next-generation instruments and detectors for x-ray, neutron, and electron-beam scattering and for research using electric and/or magnetic fields.
  - Definition of "Minimally effective" - ES-supported research leads to new instruments that are world class.
  - How will progress be measured? - Expert Review every three years will rate progress as "Excellent", "Minimally Effective" or "Insufficient".

Annual Measures

- Average achieved operation time of the scientific user facilities as a percentage of the total scheduled annual operating time. *(Efficiency measure)*
  - How will progress be measured? - Progress will be tracked quarterly through the Department of Energy's tracking system –Joule. Results will be reported in the Department's Performance and Accountability report that is published soon after the end of each fiscal year.
  - Targets -
    - 2001 – >90% 96%
    - 2002 – >90% 96%
    - 2003 – >90% 91%
    - 2004 – >90%
    - 2005 – >90%
- Cost-weighted mean percent variance from established cost and schedule baselines for major construction, upgrade, or equipment procurement projects (Cost variance listed first). *(Efficiency measure)*
  - How will progress be measured? - Progress will be tracked quarterly through the Department of Energy's tracking system –Joule. Results will be reported in the Department's Performance and Accountability report that is published soon after the end of each fiscal year.
  - Targets
    - 2001 – <10%, <10% +0.4%, -6.3%
    - 2002 – <10%, <10% -0.2%, -1.8%
    - 2003 – <10%, <10% -0.5%, -1.4%
    - 2004 – <10%, <10%
    - 2005 – <10%, <10%

- Improve Spatial Resolution: Demonstrated spatial resolutions for imaging in the hard and soft x-ray regions, and spatial information limit for an electron microscope (measured in nanometers).
    - How will progress be measured? - Progress will be tracked quarterly through the Department of Energy's tracking system –Joule. Results will be reported in the Department's Performance and Accountability report that is published soon after the end of each fiscal year.
    - Targets
        - 2002 – - 150, 24, 0.09
        - 2003 – - 130, 20, 0.09
        - 2004 – ≤115, ≤19, ≤0.08
        - 2005 – ≤100, ≤18, ≤0.08
- Improve temporal resolution: Demonstrated duration (measured in femtoseconds) and intensity (measured in millions photons per pulse) of an x-ray pulse.
    - How will progress be measured? - Progress will be tracked quarterly through the Department of Energy's tracking system –Joule. Results will be reported in the Department's Performance and Accountability report that is published soon after the end of each fiscal year.
    - Targets
        - 2002 – - 100, 0.0003
        - 2003 – - 500, 1.0
        - 2004 – ≤200, ≥0.005 (at greatly increased average brightness)
        - 2005 – ≤100, ≥100
- Number of reacting species and billions of grid points in a three-dimensional combustion reacting flow computer simulation, as a part of the Scientific Discovery through Advanced Computing (SciDAC) effort.
    - How will progress be measured? - Progress will be tracked quarterly through the Department of Energy's tracking system –Joule. Results will be reported in the Department's Performance and Accountability report that is published soon after the end of each fiscal year.
    - Targets
        - 2002 – - 8, 0.0005
        - 2003 – - 8, 0.001
        - 2004 – ≥44, ≥0.0005
        - 2005 – ≥44, ≥7

Biological and Environmental Research

Long Term Measures

- **Life Sciences** – By 2015, characterize the multi protein complexes (or the lack thereof) involving a scientifically significant fraction of a microbe's proteins. Develop computational models to direct the use and design of microbial communities to clean up waste, sequester carbon, or produce hydrogen.
    - Definition of "Success" – Multi protein complexes involving at least 85% of a microbe's proteins have been characterized. In addition, those proteins (that are part of the 85% of a microbe's proteins) thought not to be involved in forming multi protein complexes are identified experimentally. A computational model that accurately describes the potential of a microbial community to clean up waste, sequester carbon, or produce hydrogen is developed and validated experimentally by the use or reengineering of that community based on model predictions.
    - Definition of "Minimally Effective" – Multi protein complexes involving at least 65% of a microbe's proteins have been characterized. A computational model that accurately describes the potential of a microbial community to clean up waste, sequester carbon, or produce hydrogen is developed and is validated by its consistency with available data.
    - How will progress be measured? – Expert Review every three years will rate progress as "Excellent", "Minimally Effective" or "Insufficient".

- **Climate Change Research –** By 2015, deliver improved climate data & models for policy makers to determine safe levels of greenhouse gases. By 2013, reduce differences between observed temperature & model simulations at subcontinental scales using several decades of recent data
    - Definition of "Success" **-** Global and sub-continental temperatures and precipitation are successfully modeled, using fully coupled climate models of the Earth system, to reduce discrepancies between predictions made with models and observed data (1975-2010) by at least half relative to the state of modeling that supported the 2001 IPCC assessment.
    - Definition of "Minimally effective" **-** Global and sub-continental temperatures are successfully modeled, using fully coupled climate models of the Earth system, to reduce discrepancies between predictions made with models and observed data (1975-2010) by at least half relative to the state of modeling that supported the 2001 IPCC assessment.
    - How will progress be measured? **-** Expert Review every three years will rate progress as "Excellent", "Minimally Effective" or "Insufficient".

- **Environmental Remediation –** By 2015, develop science-based solutions for cleanup and long-term monitoring of DOE contaminated sites. By 2013, a significant fraction of DOE's long-term stewardship sites will employ advanced biology-based clean up solutions and science-based monitors.

- Definition of "Success" - New science-based monitors for long-term stewardship and field-tested biology-based tools for cleanup of DOE sites are in use at 25% or more of the DOE cleanup and long-term stewardship sites.
- Definition of "Minimally effective" - New science-based monitors for long-term stewardship and field-tested biology-based tools for cleanup of DOE sites are in use at 15% of the DOE cleanup and long-term stewardship sites.
- How will progress be measured? - Expert Review every three years will rate progress as "Excellent", "Minimally Effective" or "Insufficient".

Annual Measures

- **Increase the rate of DNA sequencing** -- Number (in billions) of base pairs of high quality (less than one error in 10,000 bases) DNA microbial and model organism genome sequence produced annually.
  - How will progress be measured? – Progress will be tracked quarterly through the Department of Energy's tracking system –Joule. Results will be reported in the Department's Performance and Accountability report that is published soon after the end of each fiscal year.
  - Targets -
    - 2001 – - 5.8
    - 2002 – - 12.7
    - 2003 – - 18
    - 2004 – >20
    - 2005 – >20
- **Improve climate models** -- Develop a coupled climate model with fully interactive carbon and sulfur cycles, as well as dynamic vegetation to enable simulations of aerosol effects, carbon chemistry and carbon sequestration by the land surface and oceans and the interactions between the carbon cycle and climate.
  - How will progress be measured? – Progress will be tracked quarterly through the Department of Energy's tracking system –Joule. Results will be reported in the Department's Performance and Accountability report that is published soon after the end of each fiscal year.
  - Targets -
    - 2001– - Consistency (between data and models)
    - 2002 – - Resolution
    - 2003 – - Constructed a new Climate Model for the next round of IPCC Working Group 1 Assessment simulations
    - 2004 – Testbed
    - 2005 – 3 New Parameters

- **Determine scalability of laboratory results in field environments --** Determine actual *in situ* rates of metal reduction in subsurface environments and begin to develop a numerical model to describe and predict these rates.
    - How will progress be measured? – Progress will be tracked quarterly through the Department of Energy's tracking system –Joule. Results will be reported in the Department's Performance and Accountability report that is published soon after the end of each fiscal year.
    - Targets -
        - 2002 – - Sequenced key organisms
        - 2003 – - Identified microbial populations responsible for transformation of metals and radionuclides.
        - 2004 – Quantify
        - 2005 – Predict
- Average achieved operation time of the scientific user facilities as a percentage of the total scheduled annual operating time. *(Efficiency measure)*
    - How will progress be measured? – Progress will be tracked quarterly through the Department of Energy's tracking system –Joule. Results will be reported in the Department's Performance and Accountability report that is published soon after the end of each fiscal year.
    - Targets –
        - 2001 – >90% 98%
        - 2002 – >90% 97%
        - 2003 – >90% 97%
        - 2004 – >90%
        - 2005 – >90%

Fusion Energy Sciences

Long Term Measures

- **Predictive Capability for Burning Plasmas –** By 2015, demonstrate progress in developing a predictive capability for key aspects of burning plasmas using advances in theory and simulation benchmarked against a comprehensive experimental database of stability, transport, wave-particle interaction, and edge effects.
    - Definition of "Success" – Major aspects relevant to burning plasma behavior observed in experiments prior to full operation of ITER are predicted with high accuracy and are understood.
    - Definition of "Minimally Effective" – Validate predictive models against the database for selected aspects relevant to burning plasma physics (e.g., energetic particles, instabilities, control of impurities, etc.).
    - How will progress be measured? – Expert Review every three years will rate progress as "Excellent", "Minimally Effective" or "Insufficient".

- **Configuration Optimization –** By 2015, demonstrate enhanced fundamental understanding of magnetic confinement and in improving the basis for future burning plasma experiments through research on magnetic confinement configuration optimization.
    - Definition of "Success" **-** Resolve key scientific issues and determine the confinement characteristics of a range of attractive confinement configurations.
    - Definition of "Minimally effective" **-** Provide understanding of the basic magnetic confinement issues for a number of the magnetic confinement configurations currently under investigation.
    - How will progress be measured? **-** Expert Review every three years will rate progress as "Excellent", "Minimally Effective" or "Insufficient".

- **Inertial Fusion Energy and High Energy Density Physics** – By 2015, demonstrate progress in developing the fundamental understanding and predictability of high energy density plasma physics, including potential energy producing applications.
    - Definition of "Success" **-** With the help of experimentally validated theoretical and computer models, determine the physics limits that constrain the use of inertial fusion energy drivers in future key integrated experiments needed to resolve the scientific issues for inertial fusion energy and high energy density physics.
    - Definition of "Minimally effective" - Develop and apply physical theories and mathematical techniques to model the physical processes in high-energy density plasmas and intense beams for inertial fusion energy.
    - How will progress be measured? - Expert Review every three years will rate progress as "Excellent", "Minimally Effective" or "Insufficient".

Annual Measures

- Average achieved operation time of the major national fusion facilities as a percentage of the total planned operation time. *(Efficiency measure)*
    - How will progress be measured? – Progress will be tracked quarterly through the Department of Energy's tracking system –Joule. Results will be reported in the Department's Performance and Accountability report that is published soon after the end of each fiscal year.
    - Targets -
        - 2001 – >90% 100%
        - 2002 – >90% 94%

- 2003 – >90% 81% *(NSTX operated only 4 weeks because of a magnet coil failure.)*
- 2004 – >90%
- 2005 – >90%

- Cost-weighted mean percent variance from established cost and schedule baselines for major construction, upgrade, or equipment procurement projects.
    - How will progress be measured? – Progress will be tracked quarterly through the Department of Energy's tracking system –Joule. Results will be reported in the Department's Performance and Accountability report that is published soon after the end of each fiscal year.
    - Targets -
        - 2001 – <10%,<10% - 6%, -6%
        - 2002 – <10%,<10% +5%, 0%
        - 2003 – <10%,<10% 0%, 0%
        - 2004 – <10%,<10%
        - 2005 – <10%,<10%

High Energy Physics

Long Term Measures

- By 2015, demonstrate progress in measuring the properties and interactions of the heaviest known particle (the top quark) in order to understand its particular role in the Standard Model.
    - Definition of "Success" - Measure the top quark mass to +/- 3 GeV and its couplings to other quarks with a precision of ~10% or better.
    - Definition of "Minimally effective" - Measure the top quark mass to +/- 4 GeV and its couplings to other quarks with a precision of 15% or better.
    - How will progress be measured? - Expert Review every three years will rate progress as "Excellent", "Minimally Effective" or "Insufficient".

- By 2015, demonstrate progress in measuring the matter-antimatter asymmetry in many particle decay modes with high precision.
    - Definition of "Success" - Measure the matter-antimatter asymmetry in the primary (B-> J/psi K) modes to an overall relative precision of 4% and the time-integrated asymmetry in at least 15 additional modes to an absolute precision of <10%.
    - Definition of "Minimally effective" - Measure the matter-antimatter asymmetry in the primary modes to a precision of 7% and the time-integrated asymmetry in at least 10 additional modes to an absolute precision of <15%.

- How will progress be measured? - Expert Review every three years will rate progress as "Excellent", "Minimally Effective" or "Insufficient".

- Progress in discovering or ruling out the Standard Model Higgs particle, thought to be responsible for generating mass of elementary particles.
  - Definition of "Success" - If discovered, measure the mass of the Standard Model Higgs with a precision of a few percent or better. Measure other properties of the Higgs (e.g., couplings) using several final states.
  - Definition of "Minimally effective" - Discover (>5 standard deviations) or rule out (>95% CL) a new particle consistent with the Standard Model Higgs from a mass of 114 GeV, up to a mass of 800GeV.
  - How will progress be measured? - Expert Review every three years will rate progress as "Excellent", "Minimally Effective" or "Insufficient".

- Progress in determining the pattern of the neutrino masses and the details of their mixing parameters.
  - Definition of "Success" - Confirm or refute present evidence for additional neutrino species. Confirm or rule out the current picture of atmospheric neutrino oscillations. If confirmed, measure the atmospheric mass difference (dm**2) to 15% (full width at 90% CL); and measure a non-zero value for the small neutrino mixing parameter ($\sin^2(22_{13})$), or else constrain it to be less than 0.06 (90% CL, ignoring CP and matter effects).
  - Definition of "Minimally effective" - Measure atmospheric neutrino mass difference (dm**2) to 25% using accelerator neutrino beams. Improve current limits on neutrino oscillations.
  - How will progress be measured? - Expert Review every three years will rate progress as "Excellent", "Minimally Effective" or "Insufficient".
- Progress in confirming the existence of new supersymmetric (SUSY) particles, or ruling out the minimal SUSY "Standard Model" of new physics.
  - Definition of "Success" - Extend supersymmetric quark and/or gluon searches to 2 TeV in a large class of SUSY models. For masses below 1 TeV, measure their decays into several channels and determine masses of SUSY particles produced in those decays.
  - Definition of "Minimally effective" - Extend supersymmetric quark and/or gluon searches to 1.5TeV for some SUSY models (i.e. mSugra and similar models).
  - How will progress be measured? - Expert Review every three years will rate progress as "Excellent", "Minimally Effective" or "Insufficient".

- Progress in directly discovering, or ruling out the existence of, new particles which could explain the cosmological "dark matter".
    - Definition of "Success" - Discover (>5 standard deviations) the particle responsible for dark matter, or rule out (95% CL) many current candidates for particle dark matter (e.g., neutralinos in many SUSY models).
    - Definition of "Minimally effective" - - Observe evidence for (>3 standard deviations) or rule out (90% CL) new particle(s) consistent with cosmological dark matter.
    - How will progress be measured? - Expert Review every three years will rate progress as "Excellent", "Minimally Effective" or "Insufficient".

Annual Measures

- Total integrated amount of data (measured in inverse picobarnes) delivered *(within 20% of baseline estimate)* to the CDF and D-Zero detectors at the Tevatron.
    - How will progress be measured? – Progress will be tracked quarterly through the Department of Energy's tracking system –Joule. Results will be reported in the Department's Performance and Accountability report that is published soon after the end of each fiscal year.
    - Targets –
        - 2002 – 80 83
        - 2003 – 225 240
        - 2004 – 240
        - 2005 – 390
- Total integrated amount of data (measured in inverse femtobarnes) delivered *(within 20% of baseline estimate)* to the BABAR detector at the SLAC B-factory.
    - How will progress be measured? – Progress will be tracked quarterly through the Department of Energy's tracking system –Joule. Results will be reported in the Department's Performance and Accountability report that is published soon after the end of each fiscal year.
    - Targets –
        - 2001 – 25 25
        - 2002 – 35 42
        - 2003 – 45 40 *(within 20% of 45)*
        - 2004 – 45
        - 2005 – 50
- Cost-weighted mean percentage variance from established cost and schedule baselines for major construction, upgrade, or equipment procurement projects. *(Efficiency measure)*
    - How will progress be measured? – Progress will be tracked quarterly through the Department of Energy's tracking system –Joule. Results will

be reported in the Department's Performance and Accountability report that is published soon after the end of each fiscal year.

- Targets -
  - 2002 – <10%, <10% 1.4%, -2.1%
  - 2003 – <10%, <10% 3.1%, -3.4%
  - 2004 – <10%, <10%
  - 2005 – <10%, <10%

- Average achieved operation time of the scientific user facilities as a percentage of the total scheduled annual operating time. *(Efficiency measure)*
  - How will progress be measured? - Progress will be tracked quarterly through the Department of Energy's tracking system –Joule. Results will be reported in the Department's Performance and Accountability report that is published soon after the end of each fiscal year.
  - Targets -
    - 2002 – >80% 87%
    - 2003 – >80% 83%
    - 2004 – >80%
    - 2005 – >80%

Nuclear Physics

Long Term Measures

- Progress in realizing a quantitative understanding of the quark substructure of the proton, neutron, and simple nuclei by comparison of precision measurements of their fundamental properties with theoretical calculations.
  - Definition of "Success" - Quark flavor dependence of nucleon form factors and structure functions measured; hadron states described with QCD over wide ranges of distance and energy; the nucleon-nucleon interaction mechanisms determined from QCD; precise measurements of quark and gluon contributions to nucleon spin performed.
  - Definition of "Minimally effective" - Quark and gluon contributions to the nucleon's spatial structure and spin measured; theoretical tools for hadron structure developed and tested; data show how simple nuclei can be described at a nucleon or quark-substructure level for different spatial resolution of the data.
  - How will progress be measured? - Expert Review every three years will rate progress as "Excellent", "Minimally Effective" or "Insufficient".
- Progress in searching for, and characterizing the properties of, the quark-gluon plasma by recreating brief, tiny samples of hot, dense nuclear matter.
  - Definition of "Success" - Existence of a deconfined, thermalized medium determined; its properties such as temperature history, equation of state,

energy and color transport (via jets), and screening (via heavy quark production) characterized.
    - Definition of "Minimally effective" - Existence of hot, high-density matter established; some of its properties (e.g., its initial temperature via the photon spectrum) measured, confinement properties, and energy transport (via jets) explored.
    - How will progress be measured? - Expert Review every three years will rate progress as "Excellent", "Minimally Effective" or "Insufficient".

- Progress in investigating new regions of nuclear structure, study interactions in nuclear matter like those occurring in neutron stars, and determining the reactions that created the nuclei of atomic elements inside stars and supernovae.
    - Definition of "Success" - Extensive measurements on stable and exotic nuclei and the drip lines performed; their structure established and the isospin dependence of effective interactions studied; new nuclei with neutron skins observed and studied; reactions for several astrophysical processes, including some r-process nuclei, measured.
    - Definition of "Minimally effective" – Properties of nuclei and reactions near and far from stability measured allowing study of effective interactions, collective behavior, and structural evolution; new weakly bound nuclei observed and the limits of binding explored, some reactions of stellar interest measured.
    - How will progress be measured? - Expert Review every three years will rate progress as "Excellent", "Minimally Effective" or "Insufficient".

- Progress in determining the fundamental properties of neutrinos and fundamental symmetries by using neutrinos from the sun and nuclear reactors and by using radioactive decay measurements.
    - Definition of "Success" – Double beta-decay lifetime limits extended 10-fold or more; R&D completed demonstrating precision pp solar experiment is possible; played key roles in low-energy neutrino experiments and beta-decay probing cosmologically interesting neutrino masses.
    - Definition of "Minimally effective" – Double beta-decay lifetime and neutron electric dipole moment limits extended; participated in low-energy neutrino experiments and beta-decay probing cosmologically relevant neutrino masses; parameters for quark mixing for nuclear beta-decay quantified.
    - How will progress be measured? - Expert Review every three years will rate progress as "Excellent", "Minimally Effective" or "Insufficient".

Annual Measures

- Weighted average number (within 20% of baseline estimate) of billions of events recorded by experiments in Hall A, Hall B, and Hall C, respectively, at the Continuous Electron Beam Accelerator Facility.
    - How will progress be measured? - Progress will be tracked quarterly through the Department of Energy's tracking system –Joule. Results will be reported in the Department's Performance and Accountability report that is published soon after the end of each fiscal year.
    - Targets -
        - 2001 – - 3.3, 9.9, 2.2
        - 2002 – - 2.8, 9.9, 2.7
        - 2003 – - 3.0, 9.0, 2.6
        - 2004 – 2.4, 7.2, 2.1
        - 2005 – 2.9, 9.6, 2.8
- Weighted average number (within 30% of baseline estimate) of millions of heavy-ion collision events recorded by the PHENIX and STAR detectors, respectively, at the Relativistic Heavy Ion Collider.
    - How will progress be measured? - Progress will be tracked quarterly through the Department of Energy's tracking system –Joule. Results will be reported in the Department's Performance and Accountability report that is published soon after the end of each fiscal year.
    - Targets -
        - 2002 – - 170, 8.2 (combined 2001-2002 run)
        - 2003 – - 5500, 38
        - 2004 – 900, 40
        - 2005 – 1800, 40
- Weighted average number (within 20% of baseline estimate) of billions of events recorded at the Argonne Tandem Linac Accelerator System and Holifield Radioactive Ion Beam facilities, respectively.
    - How will progress be measured? - Progress will be tracked quarterly through the Department of Energy's tracking system –Joule. Results will be reported in the Department's Performance and Accountability report that is published soon after the end of each fiscal year.
    - Targets -
        - 2001 – - 7.7, 3.4
        - 2002 – - 2.5, 5.4
        - 2003 – - 39, 2.1
        - 2004 – 25, 5.3
        - 2005 – 25, 5.3
- Average achieved operation time of the scientific user facilities as a percentage of the total scheduled annual operating time. *(Efficiency measure)*

- How will progress be measured? - Progress will be tracked quarterly through the Department of Energy's tracking system –Joule. Results will be reported in the Department's Performance and Accountability report that is published soon after the end of each fiscal year.
- Targets -
  - 2001 – >80% 85%
  - 2002 – >80% 89%
  - 2003 – >80% 88%
  - 2004 – >80%
  - 2005 – >80%

- Cost-weighted mean percent variance from established cost and schedule baselines for major construction, upgrade, or equipment procurement projects. *(Efficiency measure)*
  - How will progress be measured? - Progress will be tracked quarterly through the Department of Energy's tracking system –Joule. Results will be reported in the Department's Performance and Accountability report that is published soon after the end of each fiscal year.
  - Targets
    - 2003 – *no projects*
    - 2004 – <10%, <10%
    - 2005 – <10%, <10%
    - 2006 – <10%, <10%