Subject Categories

U.S. Department of Energy
Office of Science
Office of Scientific and Technical Information

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Department of Energy (DOE) Subject Categories

The Subject Categories presented in this document reflect the breadth of research ongoing within the U.S. Department of Energy (DOE), the single largest Federal government supporter of basic research in the physical sciences in the United States. This categorization scheme contains 50 broad subject categories, represented in two-character numeric codes. A scope description is given for each subject category. One or more subject categories can be used for categorization of scientific and technical information (STI) submitted to the DOE Office of Scientific and Technical Information (OSTI) by DOE offices, laboratories and research facilities, and awardees via the Energy Link System. The search and retrieval capabilities of OSTI products, such as the Energy Citations Database and the Information Bridge, are greatly enhanced by the assignation of subject categories to STI.

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Table of Contents

Subject Categories *by Science and Technology Topic*

Biology and Medicine

59 Basic Biological Sciences
60 Applied Life Sciences
61 Radiation Protection and Dosimetry
62 Radiology and Nuclear Medicine
63 Effects of Radiation and Other Pollutants on Biological Materials and Organisms

Chemistry

37 Inorganic, Organic, Physical, and Analytical Chemistry
38 Radiation Chemistry, Radiochemistry, and Nuclear Chemistry

Energy Storage, Conversion, and Utilization

25 Energy Storage
29 Energy Planning, Policy, and Economy
30 Direct Energy Conversion
32 Energy Conservation, Consumption, and Utilization
33 Advanced Propulsion Systems

Engineering

42 Engineering
46 Instrumentation Related to Nuclear Science and Technology
47 Other Instrumentation

Environmental Sciences

54 Environmental Sciences

Fission and Nuclear Technologies

7 Isotope and Radiation Sources
11 Nuclear Fuel Cycle and Fuel Materials
12 Management Of Radioactive Wastes, and Non-Radioactive Wastes from Nuclear Facilities
21 Specific Nuclear Reactors and Associated Plants
22 General Studies of Nuclear Reactors

Fossil Fuels

1 Coal, Lignite, and Peat
2 Petroleum
3 Natural Gas
4 Oil Shales and Tar Sands

Geosciences

58 Geosciences

Information Science

99 General and Miscellaneous

Law

99 General and Miscellaneous

Materials

36 Materials Science

Mathematics and Computing

97 Mathematics and Computing

National Defense

45 Military Technology, Weaponry, and National Defense
98 Nuclear Disarmament, Safeguards, and Physical Protection

Physics

43 Particle Accelerators
70 Plasma Physics and Fusion Technology
71 Classical and Quantum Mechanics, General Physics
72 Physics Of Elementary Particles and Fields
73 Nuclear Physics and Radiation Physics
74 Atomic and Molecular Physics
75 Condensed Matter Physics, Superconductivity and Superfluidity
77 Nanoscience and Nanotechnology
79 Astronomy and Astrophysics

Power Generation and Distribution

20 Fossil-Fueled Power Plants
24 Power Transmission and Distribution

Renewable Energy Sources

8 Hydrogen
9 Biomass Fuels
10 Synthetic Fuels
13 Hydro Energy
14 Solar Energy
15 Geothermal Energy
16 Tidal and Wave Power
17 Wind Energy

Subject Category Descriptions

01 COAL, LIGNITE, AND PEAT

Information on coal and coal products, including lignite and peat, as energy sources. Reserves, geology and exploration; surface and underground mining; transport, handling, and storage; properties and composition; preparation; processing; combustion; waste management; environmental aspects; products and by-products; health and safety aspects; legislation and regulations; and economic, industrial, and business aspects are included.

02 PETROLEUM

Information on petroleum as an energy source. Reserves, geology, and exploration; drilling and production; transport, handling, and storage; properties and composition; processing; combustion; waste management; environmental aspects; products and by-products; health and safety aspects; legislation and regulations; and economic, industrial, and business aspects are included.

03 NATURAL GAS

Information on natural gas, including liquefied natural gas, as an energy source. Reserves, geology, and exploration; drilling and production; transport, handling, and storage; properties and composition; processing; combustion; waste management; environmental aspects; products and by-products (e.g., LPG); health and safety aspects; legislation and regulations; and economic, industrial, and business aspects are included.

04 OIL SHALES AND TAR SANDS

Information on oil shales and tar sands as an energy source. Reserves, geology, and exploration; drilling, fracturing, and mining; oil production, recovery, and refining (both surface and in situ methods); transport, handling, and storage; properties and composition; combustion; waste management; environmental aspects; products and by-products; health and safety aspects; legislation and regulations; and economic, industrial, and business aspects are included.

07 ISOTOPE AND RADIATION SOURCES

Information on isotope and radiation source technology encompasses physical isotope separation and heavy water production; radiation sources (design, fabrication, operation, and industrial uses; radiation source metrology); and isotopic power supplies (use of separated isotopes or mixed fission products as sources of electric, propulsive, or thermal energy). Environmental aspects; health and safety aspects; regulation and licensing; and economic, industrial, and business aspects are included.

08 HYDROGEN

Information on hydrogen as an energy source. Methods of production (e.g., electrolysis, steam reformer processes, water gas processes, Bosch process); transport, handling, and storage; properties and composition; combustion; waste management; environmental aspects; products and by-products; health and safety aspects; legislation and regulations; and economic, industrial, and business aspects are included.

09 BIOMASS FUELS

Energy crops and wastes used directly as fuels, e.g., wood, straw, municipal wastes; fuels derived from energy crops and wastes, e.g., methane, ethane, ethanol; and biogas from sanitary landfills. Resources; production; transport, handling, and storage; properties and composition; processing (e.g., comminution, compaction, pyrolysis, fermentation, gasification, liquefaction); combustion; waste management; environmental aspects, including land use change; products and by-products; health and safety aspects; legislation and regulations; and economic, industrial, and business aspects are included.

10 SYNTHETIC FUELS

Fuels produced by chemical synthesis, e.g., inorganic hydrogen compound fuels, town gas. Production; transport, handling, and storage; properties and composition; combustion; waste management; environmental aspects; products and by-products; health and safety aspects; legislation and regulations; and economic, industrial, and business aspects are included.

11 NUCLEAR FUEL CYCLE AND FUEL MATERIALS

Information on the nuclear fuel cycle except for fuel element design, assembly, and performance (cats. 21 and 22) and waste management (cat. 12). Reserves, exploration, and mining; feed processing; uranium enrichment; fuels production and properties; spent fuels reprocessing; transport, handling, and storage; environmental aspects; health and safety aspects; legislation and regulations; and economic, industrial, and business aspects are included.

12 MANAGEMENT OF RADIOACTIVE WASTES, AND NON-RADIOACTIVE WASTES FROM NUCLEAR FACILITIES

Treatment, transport, storage, disposal, safety, and legal aspects of radioactive wastes and spent fuels. (For reprocessing of spent fuels see cat. 11.) Processing (including transmutation technology), interim or ultimate storage, and disposal of radioactive wastes (e.g. the Hanford Closure Project); processing and disposal of non-radioactive wastes generated by nuclear facilities; radioactive waste treatment plants, structures, and equipment; and tritium processing, containment, and recovery are included.

13 HYDRO ENERGY

Hydroelectric power plants, retrofitting of existing dams for power, and hydroelectric dam safety and environmental studies, as well as the extraction of energy from the Florida Current, the Gulf Stream, or undammed, free-flowing streams. Resources and availability; site geology and meteorology; generating plant design and operation; power-conversion systems; environmental aspects; health and safety aspects; legislation and regulations; and economic, industrial, and business aspects are included.

14 SOLAR ENERGY

Information on all aspects of the utilization of solar energy, such as the conversion of solar radiation to useful amounts of electric energy, the use of solar energy for space heating and cooling, water heating, agricultural or industrial process heat, or cooking, refrigeration, or desalination; or any other use of solar energy that might contribute to the total energy budget. All technical aspects of the design, research and development, manufacture, testing, and operation of solar cells and solar collectors and concentrators, along with materials and components used therein. Methods of solar energy conversion include photovoltaic,

thermionic, thermoelectric, photochemical, photobiological, and thermochemical conversion. Power systems include photovoltaic and solar thermal systems (of small, intermediate, and large scale for residential, community, and utility power production and remote applications such as telecommunications and irrigation) and ocean energy systems employing temperature or salinity gradients. Additional aspects include methods for latent and sensible heat storage; resources and availability; environmental aspects; health and safety; legislation and regulations; and economic, industrial, and business aspects.

15 GEOTHERMAL ENERGY

Information leading to the development and utilization of geothermal energy as an energy source. Fundamental data include geothermal resources and availability, the geology and hydrology of geothermal areas, and geothermal data and theory (properties of aqueous solutions and of minerals and rocks, rock-water-gas interactions). Technological areas encompass methods of geothermal exploration, drilling, and well logging; geothermal engineering (e.g., well hardware, fluid transmission, reservoir and well performance, reservoir stimulation and extraction technology); geothermal power plants; direct utilization of geothermal heat; and products and by-products. Additional aspects include waste management; environmental aspects; health and safety; legislation and regulations; and economic, industrial, and business aspects.

16 TIDAL AND WAVE POWER

Energy obtained from waves and tides as distinguished from ocean currents (cat. 13). Resources and availability; design and operation of tidal power plants and power conversion systems; wave energy converters; environmental aspects; health and safety aspects; legislation and regulations; and economic, industrial, and business aspects are included.

17 WIND ENERGY

Aspects of wind energy include the following: wind resources and availability (climatology); wind energy engineering (e.g., turbine design and operation, power-conversion systems); environmental aspects; health and safety; legislation and regulations; and economic, industrial, and business aspects.

20 FOSSIL-FUELED POWER PLANTS

The focus is on the design and operation of utility-size fossil-fueled power plants. Routine uses of power plant hardware (fuses, motors, turbines, generators, and standard electrical components) are not included, but new designs, developments, and technologies are appropriate. Operational aspects include in-plant fuel preparation and handling, power cycles, heat utilization, cooling and heat transfer systems, and off-peak energy storage. Waste management; environmental aspects; health and safety aspects; legislation and regulations; and economic, industrial, and business aspects are also included.

21 SPECIFIC NUCLEAR REACTORS AND ASSOCIATED PLANTS

Design, development, construction, operation, decommissioning, dismantling, and accident analysis of specific fission power reactors. Types of power reactors include, for example, BWR, PWR, PHWR, WWER, GCR, AGR, HTGR and LMFBR types; information on associated reactor plants as energy sources for electricity and heat generation and other applications is also included. Further examples of power reactors are mobile, package,

transportable, and propulsion reactors. Reactor safety, regulation, licensing, economics, and environmental impacts of these reactor types are also included.

22 GENERAL STUDIES OF NUCLEAR REACTORS

General studies of fission reactor physics and engineering and of generally applicable components such as control systems. Design and performance of fuel elements, components and accessories of reactors of unspecified type. Design, development, construction, operation, decommissioning, dismantling, and accident analysis of non-power reactors such as research reactors (including zero-power reactors and critical assemblies) and test, training, production, irradiation, materials testing, and materials processing reactors. Reactor safety, regulation, licensing, economics, and environmental impacts of these reactor types are also included.

24 POWER TRANSMISSION AND DISTRIBUTION

Design, development, and new technologies of power systems and power transmission, such as transformers, switchgear, converters, and cables. Environmental aspects; health and safety; legislation and regulations; and economic, industrial, and business aspects are included.

25 ENERGY STORAGE

Methods for storing energy in a readily recoverable form for later use. These methods may be mechanical, electromagnetic, thermal, or chemical, and are exemplified by flywheels, compressed and liquefied gas, capacitor banks, magnetic energy storage, thermal energy storage, and chemical energy storage, in particular, electric batteries. Environmental aspects; health and safety; legislation and regulations; and economic, industrial, and business aspects are included.

29 ENERGY PLANNING, POLICY, AND ECONOMY

General aspects of energy planning, policy, and policy analysis (non-technical documents only). Short- and long-term planning and policy aspects of energy consumption, utilization, and conservation; shortages, including blackouts and brownouts; energy storage and transport (e.g. by means of pipelines or liquid hydrogen); district heating and cooling; waste heat utilization; electric power and its generation; combined cycles; and specific energy sources such as fossil fuels, hydrogen and synthetic fuels, nuclear energy, and unconventional energy sources (solar, geothermal, wind, tides, etc.). Further topics are the economics and sociology of energy production and use, such as supply and demand, cost comparisons and economic evaluations, and environmental, health, and safety aspects. Broad, generally applicable documents on total energy systems, energy management, energy analysis and modeling, legislation and regulation, and the research, development, demonstration, and commercialization programs of governments and private organizations are also included, along with documents on their organizational structures.

30 DIRECT ENERGY CONVERSION

Methods and devices for converting heat or other forms of energy into electrical energy without intermediate conversion into mechanical work. MHD generators, EHD generators, thermoelectric generators, thermionic generators, and fuel cells are included, as well as other types of converters (piezoelectric, ferroelectric, ferromagnetic, magnetothermoelectric, photoelectromagnetic, magnetostrictive, etc.).

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

Equipment and methods to reduce energy consumption, to increase energy efficiency, or to enable the substitution of more plentiful or environmentally favorable energy sources with application to buildings technology, in transportation, in industry and agriculture, and within municipalities and communities. Examples are the optimization of materials, equipment, and processes for reducing energy consumption; waste heat recovery and utilization; and waste management for energy recovery or recycling. Consumer motivation and behavior studies and educational tools that deal with energy conservation and consumption are also included.

33 ADVANCED PROPULSION SYSTEMS

Design and development of advanced propulsion systems for automobiles, buses, trucks, ships, aircraft, and trains - e.g., power plants, components, and devices that promise better fuel economy, less maintenance, and increased service life; more-efficient power cycles; better emission-control devices; and feasibility studies on the use of alternative fuels such as hydrogen or alcohol fuels. Internal combustion engines, external combustion engines, flywheel propulsion, electric-powered systems, and hybrid systems are included, along with relevant vehicle design factors (body and chassis, engine-transmission matching, etc.)

36 MATERIALS SCIENCE

Preparation and fabrication, structure and phase studies, mechanical and physical properties, and corrosion and erosion of metals, alloys, ceramics, cermets, refractories, composites, polymers, plastics, and other materials of significance in energy science, such as boron, graphite, concrete, and rock (e.g. rock and mineral magnetism). In addition, the effects of radiation on the mechanical integrity or physical properties of any material are also included.

37 INORGANIC, ORGANIC, PHYSICAL, AND ANALYTICAL CHEMISTRY

Analytical and separations chemistry (including activation, nuclear reaction, radiometric, radiochemical, and spectral procedures); inorganic, organic, and physical chemistry; electrochemistry; photochemistry; and combustion, pyrolysis and high-temperature chemistry when related to either basic or applied energy science and technology. Isotope effects on properties of elements and compounds and isotope exchange are also included.

38 RADIATION CHEMISTRY, RADIOCHEMISTRY, AND NUCLEAR CHEMISTRY

Hot-atom chemistry (chemical reactions of atoms or ions of high kinetic energy (more than 1 eV) resulting from nuclear transformations), properties of radioactive materials, preparation of radioactively labeled compounds (including chemical separation and preparation of radioisotopes), and radiation chemistry (radiation-induced chemical reactions, G value determination, chemical radiation effects on solids, liquids, and gases).

42 ENGINEERING

General engineering information directly related to energy technology, including facilities, equipment and techniques (e.g. handling equipment and procedures, shipping containers, transport and storage facilities); heat transfer and fluid flow (nucleate boiling, boiling burnout, critical heat flux, two-phase flow, flow in rod bundles); materials testing; combustion systems; mining and underground engineering; marine engineering; power cycles; components, electron devices and circuits; and peaceful uses of nuclear explosions.

43 PARTICLE ACCELERATORS

Design, development, operation, and components of particle accelerators. Beam dynamics, field calculations, and ion optics; auxiliaries and components (ion sources, injection and extraction systems, experimental facilities and equipment); and storage rings are included.

45 MILITARY TECHNOLOGY, WEAPONRY, AND NATIONAL DEFENSE

Information on the scientific and technical aspects of conventional and nuclear weapons and warfare and national defense issues. Chemical explosions and explosives, nuclear explosions and explosives, nuclear explosion detection, nuclear and radiological warfare, strategic defense initiative, and chemical and biological warfare are included.

46 INSTRUMENTATION RELATED TO NUCLEAR SCIENCE AND TECHNOLOGY

Particle and radiation detectors and monitors (such as radiation dosimeters, nuclear spectroscopic instrumentation, high-energy physics instrumentation, and radiometric instruments) as well as other nuclear science-related instrumentation, e.g. flowmeters, pressure gages, and heat sensors; radiation effects on instruments, components, and electronic systems.

47 OTHER INSTRUMENTATION

Instrumentation associated with energy research and energy source exploitation, including instruments used in well logging and in thermal, optical, geophysical, meteorological, or other energy-related applications.

54 ENVIRONMENTAL SCIENCES

Information on the effects of any energy-related activity on the environment, on methods for mitigating or eliminating adverse effects, and on technical aspects of ensuring that energy-related activities are environmentally safe and socially acceptable. This area covers all aspects of global climate change and climate change mitigation. Baseline studies, site resource and use studies, and monitoring and transport of chemicals, radioactive materials, and thermal effluents within the atmospheric, terrestrial, and aquatic environments are included.

58 GEOSCIENCES

Aspects of geology, hydrology, seismology, tectonics, volcanology, mineralogy, petrology, geochemistry, and oceanology. Solid earth physics, geoelectricity, geomagnetism, paleomagnetism, and environmental magnetism are included.

59 BASIC BIOLOGICAL SCIENCES

Studies of living organisms and components of living organisms; identification of functions, activities, and phenomena associated with these organisms; and studies to establish norms from which effects of energy production, conversion, or use can be determined. Branches of biological science specifically included are behavioral biology; biochemistry and molecular biology; cytology; genetics and genomics, including DNA sequencing and other aspects of genome research; metabolism; microbiology; morphology; pathology; and physiological systems.

60 APPLIED LIFE SCIENCES

Plant cultivation and breeding (crop and plant improvement by development of mutants, plant nutrition, metabolism, fertilizer utilization, irrigation studies, assessment of seed quality, stimulation of plant growth); pest and disease control related to human, animal, and plant parasitic diseases, to pathogens, and to disease transmission; procedures in vaccine production and reactions of organisms to such vaccines; pest ecology, pesticides, and insect control; food protection, preservation, and human nutrition evaluation (procedures for food and animal feed, extension of storage life, disinfestation, food quality and monitoring); and animal husbandry (nutrition, metabolism, and breeding of domestic animals, veterinary science). The use of radiation in the above contexts is included.

61 RADIATION PROTECTION AND DOSIMETRY

Radiation protection standards dealing with the presence of radioactive materials or with the operation of reactors or other nuclear equipment or facilities; radiation protection procedures to provide radiation protection, prevention of contamination, and decontamination; and dosimetry and monitoring of patients, medical personnel, and nuclear industry workers, as well as population dose estimates, collective dose and dose commitment (from background radiation, radiation accidents, medical or industrial use of radioisotopes and ionizing radiation, or contaminated food), and absorbed doses in man, animals, plants, and other biological systems, as well as tissue-equivalent materials and phantoms). Legal aspects of protecting personnel, the public, and the environment against contamination are also included.

62 RADIOLOGY AND NUCLEAR MEDICINE

The use of external radiation and radioisotopes in diagnosis and therapy. Radiations of interest are x rays, bremsstrahlung, gamma rays, neutrons, and charged particles. The use of stable isotopes in diagnostic procedures as well as other medical techniques is also included.

63 EFFECTS OF RADIATION AND OTHER POLLUTANTS ON BIOLOGICAL MATERIALS AND ORGANISMS

Effects of nuclear particles, accelerated electrons and ions, gamma rays or x rays on living organisms, including cells, microorganisms, or biochemicals; ultraviolet light on microorganisms, cells, or biochemicals; thermal effluents from energy production, use, or conservation or other thermal discharges on living organisms; and noise produced in energy production, conversion, or use. The concept of radiation effects includes the effect itself, radiomimetic effects, and any information related to the effect and the influence of variables such as dose, dose rate, or LET, as well as modification of radiation effects by radioprotective or effect-enhancing substances and studies on these substances. Radionuclide effects, kinetics, and toxicology of radioactive materials or deuterium in living organisms; metabolism and toxicology of chemicals associated with an energy cycle; effects from global climate changes; and health hazards from any energy-related activities, such as power transmission lines, are also included.

70 PLASMA PHYSICS AND FUSION TECHNOLOGY

Plasma physics studies include plasma production, confinement, heating, and current drive; kinetics and transport; waves, oscillations, and instabilities; fluid and MHD properties; particle orbits, collisions, and reactions; impurities; and diagnostic techniques and instrumentation. Fusion technology encompasses the design and performance of magnetic

and inertial confinement devices (including laser-driven applications) and their various components (first wall, liners, diverters, magnet coils and fields, power supplies, blankets and cooling systems, heating and fueling systems, fuels, and power conversion systems), along with economic aspects of fusion energy.

71 CLASSICAL AND QUANTUM MECHANICS, GENERAL PHYSICS

Classical mechanics of interest for energy science and technology; general aspects of quantum mechanics and scattering theory; basic cryogenic studies; vacuum production and techniques at cryogenic temperatures; ultrafast phenomena; laser-driven science; beam production and transport of beams (electron, neutron, ion, atomic, and molecular) not for specific applications; nonisotopic sources (electron, neutron, ion) not developed for specific applications; auroral, ionospheric, and magnetospheric phenomena; and other physical sciences such as statistical physics, thermodynamics, electricity and magnetism, electrodynamics, optics, acoustics, etc.

72 PHYSICS OF ELEMENTARY PARTICLES AND FIELDS

Theory of fields and strings (e.g. Kaluza-Klein theories, Schwinger source theory, Bethe-Salpeter equations, relativistic wave equations, lattice gauge theory); symmetry and symmetry breaking; conservation laws; currents and their properties; S-matrix theory; Regge formalism; relativistic scattering theory; unified theories and models; quantum electrodynamics (QED); quantum chromodynamics (QCD); models for strong interactions; properties of baryons, baryon resonances, mesons, meson resonances, leptons, and other particles (quarks, gluons, intermediate bosons, Higgs bosons, magnetic monopoles, etc.); weak, electromagnetic, and strong interactions of photons, leptons, and hadrons; decays of baryons, mesons, leptons, and intermediate bosons; electromagnetic processes and properties of elementary particles.

73 NUCLEAR PHYSICS AND RADIATION PHYSICS

Properties of nuclei and nuclear energy levels, nuclear structure models and methods, nuclear radioactivity and electromagnetic transitions, and nuclear reactions and scattering and fission. The physics of radiation transport as neutrons, photons, gamma rays, and other particles interact with and pass through bulk matter is also included.

74 ATOMIC AND MOLECULAR PHYSICS

Electronic structure and energy-level transitions of atoms and molecules; atomic and molecular spectra; interactions of atoms and molecules with photons; collision phenomena and dynamics (for collisions of electrons, ions, atoms, and molecules with one another); and properties of atoms and molecules (moments, polarizability, ionization potentials, electron affinities, bond strengths, dissociation energies, etc.), including positronium, muonium, muonic and mesic atoms and molecules, and hyperonic atoms and molecules.

75 CONDENSED MATTER PHYSICS, SUPERCONDUCTIVITY AND SUPERFLUIDITY

Use of nuclear techniques or measurement methods in studies of the structure of solids and liquids, such as magnetic resonance and NMR; solid-state plasma; physics of surfaces, interfaces, and thin films; interactions of beams (photons, electrons, positrons, neutrons, ions, atoms, and molecules) with condensed matter, where the interest is in the effect itself at the

microscopic level and not in the material in which it takes place; Auger emission; secondary emission; sputtering; quantum physics aspects of condensed matter (superconductivity, superconducting devices, superfluidity, etc.); and basic studies of direct energy conversion (magnetohydrodynamics (MHD), electrohydrodynamics (EHD), thermoelectric effect, thermionic emission, etc.).

77 NANOSCIENCE AND NANOTECHNOLOGY

All aspects of nanoscience and nanotechnology, which encompasses both the control of matter and the fabrication of devices with critical dimensions in the nanometer size range. Theoretical and experimental studies as well as applications are included. Examples are the study and application of nanotubes and quantum dots, drug delivery, the manufacture of polymers based on molecular structure, and the design of computer chip layouts.

79 ASTRONOMY AND ASTROPHYSICS

Aspects of astronomy and astrophysics such as the following: solar phenomena (sunspots, solar flares, solar wind, solar magnetic fields), planetary evolution and radiation belts, extraterrestrial matter, neutron stars, quasars, black holes, cosmic radio and x-ray sources, stellar and galactic evolution, cosmic radiation and molecules in interstellar space, cosmology, theories of gravitation (supergravity, General Relativity Theory and tests thereof), gravitational collapse and the detection of gravitational waves (theory and devices).

97 MATHEMATICS AND COMPUTING

Basic mathematics, mathematical and computer modeling, computer programming, supercomputers and supercomputing.

98 NUCLEAR DISARMAMENT, SAFEGUARDS, AND PHYSICAL PROTECTION

Information on arms control such as negotiations and treaties to reduce weapon stockpiles and delivery systems, on limiting the spread of weapon technologies, and on verification of compliance with such agreements. Policy, negotiations, and legislation; proliferation; monitoring (including remote and on-site inspections); nuclear materials management, physical protection, and technical and nontechnical aspects of nuclear safeguards to guard against the diversion of nuclear materials are included.

99 GENERAL AND MISCELLANEOUS

Research interests of energy organizations in the areas of institutional management, information science, and general law. Descriptions and evaluations of systems for collecting, analyzing, and publishing data and literature related to energy science and its applications are included, as are documents dealing with the organization, administration, and general description of institutes and programs, directories, bibliographies, standardized terminology, etc., related to some facet of energy technology.

Subject Categories - Numeric Order

01 COAL, LIGNITE, AND PEAT

02 PETROLEUM

03 NATURAL GAS

04 OIL SHALES AND TAR SANDS

07 ISOTOPE AND RADIATION SOURCES

08 HYDROGEN

09 BIOMASS FUELS

10 SYNTHETIC FUELS

11 NUCLEAR FUEL CYCLE AND FUEL MATERIALS

12 MANAGEMENT OF RADIOACTIVE WASTES, AND NON-RADIOACTIVE WASTES FROM NUCLEAR FACILITIES

13 HYDRO ENERGY

14 SOLAR ENERGY

15 GEOTHERMAL ENERGY

16 TIDAL AND WAVE POWER

17 WIND ENERGY

20 FOSSIL-FUELED POWER PLANTS

21 SPECIFIC NUCLEAR REACTORS AND ASSOCIATED PLANTS

22 GENERAL STUDIES OF NUCLEAR REACTORS

24 POWER TRANSMISSION AND DISTRIBUTION

25 ENERGY STORAGE

29 ENERGY PLANNING, POLICY, AND ECONOMY

30 DIRECT ENERGY CONVERSION

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

33 ADVANCED PROPULSION SYSTEMS

36 MATERIALS SCIENCE

37 INORGANIC, ORGANIC, PHYSICAL, AND ANALYTICAL CHEMISTRY

38 RADIATION CHEMISTRY, RADIOCHEMISTRY, AND NUCLEAR CHEMISTRY

42 ENGINEERING

43 PARTICLE ACCELERATORS

45 MILITARY TECHNOLOGY, WEAPONRY, AND NATIONAL DEFENSE

46 INSTRUMENTATION RELATED TO NUCLEAR SCIENCE AND TECHNOLOGY

47 OTHER INSTRUMENTATION

54 ENVIRONMENTAL SCIENCES

58 GEOSCIENCES

59 BASIC BIOLOGICAL SCIENCES

60 APPLIED LIFE SCIENCES

61 RADIATION PROTECTION AND DOSIMETRY

62 RADIOLOGY AND NUCLEAR MEDICINE

63 EFFECTS OF RADIATION AND OTHER POLLUTANTS ON BIOLOGICAL MATERIALS AND ORGANISMS

70 PLASMA PHYSICS AND FUSION TECHNOLOGY

71 CLASSICAL AND QUANTUM MECHANICS, GENERAL PHYSICS

72 PHYSICS OF ELEMENTARY PARTICLES AND FIELDS

73 NUCLEAR PHYSICS AND RADIATION PHYSICS

74 ATOMIC AND MOLECULAR PHYSICS

75 CONDENSED MATTER PHYSICS, SUPERCONDUCTIVITY AND SUPERFLUIDITY

77 NANOSCIENCE AND NANOTECHNOLOGY

79 ASTRONOMY AND ASTROPHYSICS

97 MATHEMATICS AND COMPUTING

98 NUCLEAR DISARMAMENT, SAFEGUARDS, AND PHYSICAL PROTECTION

99 GENERAL AND MISCELLANEOUS

Subject Categories – Alpha Order

ADVANCED PROPULSION SYSTEMS

APPLIED LIFE SCIENCES

ASTRONOMY AND ASTROPHYSICS

ATOMIC AND MOLECULAR PHYSICS

BASIC BIOLOGICAL SCIENCES

BIOMASS FUELS

CLASSICAL AND QUANTUM MECHANICS, GENERAL PHYSICS

COAL, LIGNITE, AND PEAT

CONDENSED MATTER PHYSICS, SUPERCONDUCTIVITY AND SUPERFLUIDITY

DIRECT ENERGY CONVERSION

EFFECTS OF RADIATION AND OTHER POLLUTANTS ON BIOLOGICAL MATERIALS AND ORGANISMS

ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

ENERGY PLANNING, POLICY, AND ECONOMY

ENERGY STORAGE

ENGINEERING

ENVIRONMENTAL SCIENCES

FOSSIL-FUELED POWER PLANTS

GENERAL AND MISCELLANEOUS

GENERAL STUDIES OF NUCLEAR REACTORS

GEOSCIENCES

GEOTHERMAL ENERGY

HYDRO ENERGY

HYDROGEN

INORGANIC, ORGANIC, PHYSICAL, AND ANALYTICAL CHEMISTRY

INSTRUMENTATION RELATED TO NUCLEAR SCIENCE AND TECHNOLOGY

ISOTOPE AND RADIATION SOURCES

MANAGEMENT OF RADIOACTIVE WASTES, AND NON-RADIOACTIVE WASTES FROM NUCLEAR FACILITIES

MATERIALS SCIENCE

MATHEMATICS AND COMPUTING

MILITARY TECHNOLOGY, WEAPONRY, AND NATIONAL DEFENSE

NANOSCIENCE AND NANOTECHNOLOGY

NATURAL GAS
NUCLEAR DISARMAMENT, SAFEGUARDS, AND PHYSICAL PROTECTION
NUCLEAR FUEL CYCLE AND FUEL MATERIALS
NUCLEAR PHYSICS AND RADIATION PHYSICS
OIL SHALES AND TAR SANDS
OTHER INSTRUMENTATION
PARTICLE ACCELERATORS
PETROLEUM
PHYSICS OF ELEMENTARY PARTICLES AND FIELDS
PLASMA PHYSICS AND FUSION TECHNOLOGY
POWER TRANSMISSION AND DISTRIBUTION
RADIATION CHEMISTRY, RADIOCHEMISTRY, AND NUCLEAR CHEMISTRY
RADIATION PROTECTION AND DOSIMETRY
RADIOLOGY AND NUCLEAR MEDICINE
SOLAR ENERGY
SPECIFIC NUCLEAR REACTORS AND ASSOCIATED PLANTS
SYNTHETIC FUELS
TIDAL AND WAVE POWER
WIND ENERGY