NASA/SP—2000–6112

Probabilistic Risk Assessment

A Bibliography

National Aeronautics and Space Administration

July 2000

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Introduction

Probabilistic risk assessment is an integration of failure modes and effects analysis (FMEA), fault tree analysis, and other techniques to assess the potential for failure and to help find ways to reduce risk. This bibliography contains references to documents in the NASA Scientific and Technical Information (STI) Database. The selections are based on the major concepts and other NASA Thesaurus terms, including 'probability theory.' An abstract is included with most citations.

Items are first categorized by 10 major subject divisions, then further divided into 76 specific subject categories, based on the NASA Scope and Subject Category Guide. The subject divisions and categories are listed in the Table of Contents together with a note for each that defines its scope and provides any cross-references.

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Table of Contents

Subject Divisions

Document citations are grouped first by the following divisions. Select a division title to view the category-level Table of Contents.

A. Aeronautics
B. Astronautics
C. Chemistry and Materials
D. Engineering
E. Geosciences
F. Life Sciences
G. Mathematical and Computer Sciences
H. Physics
I. Social and Information Sciences
J. Space Sciences
K. General

Indexes

Two indexes are available. You may use the find command under the tools menu while viewing the PDF file for direct match searching on any text string. You may also select either of the two indexes provided for searching on *NASA Thesaurus* subject terms and personal author names.

Subject Term Index

Personal Author Index

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Subject Categories of the Division A. Aeronautics

Select a category to view the collection of records cited. N.A. means no abstracts in that category.

01 Aeronautics (General) N.A.

Includes general research topics related to manned and unmanned aircraft and the problems of flight within the Earth's atmosphere. Also includes manufacturing, maintenance, and repair of aircraft. For specific topics in aeronautics see *categories 02 through 09*. For information related to space vehicles see *12 Astronautics*.

02 Aerodynamics N.A.

Includes aerodynamics of flight vehicles, test bodies, airframe components and combinations, wings, and control surfaces. Also includes aerodynamics of rotors, stators, fans and other elements of turbomachinery. For related information, see also *34 Fluid Mechanics and Heat Transfer.*

03 Air Transportation and Safety 1

Includes passenger and cargo air transport operations; aircraft ground operations; flight safety and hazards; and aircraft accidents. Systems and hardware specific to ground operations of aircraft and to airport construction are covered in *09 Research and Support Facilities (Air)*. Air traffic control is covered in *04 Aircraft Communications and Navigation*. For related information see also *16 Space Transportation and Safety*; and *85 Technology Utilization and Surface Transportation*.

04 Aircraft Communications and Navigation 2

Includes all modes of communication with and between aircraft; air navigation systems (satellite and ground based); and air traffic control. For related information see also *06 Avionics and Aircraft Instrumentation*; *17 Space Communications; Spacecraft Communications, Command and Tracking*, and *32 Communications and Radar.*

05 Aircraft Design, Testing and Performance N.A.

Includes all stages of design of aircraft and aircraft structures and systems. Also includes aircraft testing, performance, and evaluation, and aircraft and flight simulation technology. For related information, see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*. For land transportation vehicles, see *85 Technology Utilization and Surface Transportation*.

06 Avionics and Aircraft Instrumentation N.A.

Includes all avionics systems, cockpit and cabin display devices; and flight instruments intended for use in aircraft. For related information, see also *04 Aircraft Communications and Navigation; 08 Aircraft Stability and Control; 19 Spacecraft Instrumentation and Astrionics;* and *35 Instrumentation and Photography.*

07 Aircraft Propulsion and Power N.A.

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft. For related information see also *20 Spacecraft Propulsion and Power*, *28 Propellants and Fuels*, and *44 Energy Production and Conversion*.

08 Aircraft Stability and Control N.A.

Includes flight dynamics, aircraft handling qualities; piloting; flight controls; and autopilots. For related information, see also *05 Aircraft Design, Testing and Performance* and *06 Avionics and Aircraft Instrumentation*.

09 Research and Support Facilities (Air) N.A.

Includes airports, runways, hangars, and aircraft repair and overhaul facilities; wind tunnels, water tunnels, and shock tubes; flight simulators; and aircraft engine test stands. Also includes airport ground equipment and systems. For airport ground operations see *03 Air Transportation and Safety.* For astronautical facilities see *14 Ground Support Systems and Facilities (Space).*

Subject Categories of the Division B. Astronautics

Select a category to view the collection of records cited. N.A. means no abstracts in that category.

12 Astronautics (General) 2

Includes general research topics related to space flight and manned and unmanned space vehicles, platforms or objects launched into, or assembled in, outer space; and related components and equipment. Also includes manufacturing and maintenance of such vehicles or platforms. For specific topics in astronautics see *categories 13 through 20*. For extraterrestrial exploration, see *91 Lunar and Planetary Science and Exploration*.

13 Astrodynamics N.A.

Includes powered and free-flight trajectories; and orbital and launching dynamics.

14 Ground Support Systems and Facilities (Space) N.A.

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and test chambers and simulators. Also includes extraterrestrial bases and supporting equipment. For related information see also *09 Research and Support Facilities (Air)*.

15 Launch Vehicles and Launch Operations N.A.

Includes all classes of launch vehicles, launch/space vehicle systems, and boosters; and launch operations. For related information see also *18 Spacecraft Design, Testing, and Performance; and 20 Spacecraft Propulsion and Power.*

16 Space Transportation and Safety 3

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques. For related information, see also *03 Air Transportation and Safety* and *15 Launch Vehicles and Launch Vehicles,* and *18 Spacecraft Design, Testing and Performance*. For space suits, see *54 Man/System Technology and Life Support*.

17 Space Communications, Spacecraft Communications, Command and Tracking 7

Includes space systems telemetry; space communications networks; astronavigation and guidance; and spacecraft radio blackout. For related information, see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

18 Spacecraft Design, Testing and Performance 7

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and spacecraft control and stability characteristics. For life support systems, see *54 Man/System Technology and Life Support*. For related information, see also *05 Aircraft Design, Testing and Performance*, *39 Structural Mechanics, and 16 Space Transportation and Safety.*

19 Spacecraft Instrumentation and Astrionics N.A.

Includes the design, manufacture, or use of devices for the purpose of measuring, detecting, controlling, computing, recording, or processing data related to the operation of space vehicles or platforms. For related information, see also *06 Aircraft Instrumentation and Avionics;* For spaceborne instruments not integral to the vehicle itself see *35 Instrumentation and Photography*; For spaceborne telescopes and other astronomical instruments see *89 Astronomy, Instrumentation and Photography*; For spaceborne telescopes and other astronomical instruments see *89 Astronomy.*

20 Spacecraft Propulsion and Power 8

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxiliary power sources. For related information, see also *07 Aircraft Propulsion and Power; 28 Propellants and Fuels; 15 Launch Vehicles and Launch Operations;* and *44 Energy Production and Conversion*.

Subject Categories of the Division C. Chemistry and Materials

Select a category to view the collection of records cited. N.A. means no abstracts in that category.

23 Chemistry and Materials (General) N.A.

Includes general research topics related to the composition, properties, structure, and use of chemical compounds and materials as they relate to aircraft, launch vehicles, and spacecraft. For specific topics in chemistry and materials see *categories 24 through 29*. For astrochemistry see category *90 Astrophysics*.

24 Composite Materials 10

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

25 Inorganic, Organic, and Physical Chemistry N.A.

Includes the analysis, synthesis, and use inorganic and organic compounds; combustion theory; electrochemistry; and photochemistry. For related information see also *34 Fluid Dynamics and Thermodynamics, For astrochemistry see category 90 Astrophysics*.

26 Metals and Metallic Materials N.A.

Includes physical, chemical, and mechanical properties of metals and metallic materials; and metallurgy.

27 Nonmetallic Materials N.A.

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials. For composite materials see *24 Composite Materials.*

28 Propellants and Fuels N.A.

Includes rocket propellants, igniters and oxidizers; their storage and handling procedures; and aircraft fuels. For nuclear fuels see *73 Nuclear Physics*. For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power*, and *44 Energy Production and Conversion*.

29 Space Processing N.A.

Includes space-based development of materials, compounds, and processes for research or commercial application. Also includes the development of materials and compounds in simulated reduced–gravity environments. For legal aspects of space commercialization see *84 Law, Political Science and Space Policy.*

Subject Categories of the Division D. Engineering

Select a category to view the collection of records cited. N.A. means no abstracts in that category.

31 Engineering (General) 10

Includes general research topics to engineering and applied physics, and particular areas of vacuum technology, industrial engineering, cryogenics, and fire prevention. For specific topics in engineering see *categories 32 through 39*.

32 Communications and Radar N.A.

Includes radar; radio, wire, and optical communications; land and global communications; communications theory. For related information see also *04 Aircraft Communications and Navigation;* and *17 Space Communications, Spacecraft Communications, Command and Tracking;* for search and rescue see *03 Air Transportation and Safety*, and *16 Space Transportation and Safety.*

33 Electronics and Electrical Engineering 13

Includes development, performance, and maintainability of electrical/electronic devices and components; related test equipment. and microelectronics and integrated circuitry. For related information see also *60 Computer Operations and Hardware;* and *76 Solid-State Physics*. For communications equipment and devices see *32 Communications and Radar.*

34 Fluid Mechanics and Thermodynamics N.A.

Includes fluid dynamics and kinematics and all forms of heat transfer; boundary layer flow; hydrodynamics; hydraulics; fluidics; mass transfer and ablation cooling. For related information see also *02 Aerodynamics.*

35 Instrumentation and Photography N.A.

Includes remote sensors; measuring instruments and gauges; detectors; cameras and photographic supplies; and holography. For aerial photography see *43 Earth Resources and Remote Sensing*. For related information see also *06 Avionics and Aircraft Instrumentation;* and *19 Spacecraft Instrumentation*.

36 Lasers and Masers N.A.

Includes lasing theory, laser pumping techniques, maser amplifiers, laser materials, and the assessment of laser and maser outputs. For cases where the application of the laser or maser is emphasized see also the specific category where the application is treated. For related information see also *76 Solid-State Physics*.

37 Mechanical Engineering 14

Includes mechanical devices and equipment; machine elements and processes. For cases where the application of a device or the host vehicle is emphasized see also the specific category where the application or vehicle is treated. For robotics see *63 Cybernetics, Artificial Intelligence, and Robotics*; and *54 Man/System Technology and Life Support*.

38 Quality Assurance and Reliability 14

Includes approaches to, and methods for reliability analysis and control, inspection, maintainability, and standardization.

39 Structural Mechanics 18

Includes structural element design, analysis and testing; dynamic responses of structures; weight analysis; fatigue and other structural properties; and mechanical and thermal stresses in structure. For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance*.

Subject Categories of the Division E. Geosciences

Select a category to view the collection of records cited. N.A. means no abstracts in that category.

42 Geosciences (General) N.A.

Includes general research topics related to the Earth sciences, and the specific areas of petrology, minerology, and general geology. For other specific topics in geosciences see *categories 42 through 48*.

43 Earth Resources and Remote Sensing N.A.

Includes remote sensing of earth features, phenomena and resources by aircraft, balloon, rocket, and spacecraft; analysis or remote sensing data and imagery; development of remote sensing products; photogrammetry; and aerial photographs. For instrumentation see *35 Instrumentation and Photography.*

44 Energy Production and Conversion 19

Includes specific energy conversion systems, e.g., fuel cells; and solar, geothermal, windpower, and waterwave conversion systems; energy storage; and traditional power generators. For technologies related to nuclear energy production see *73 Nuclear Physics*. For related information see also *07 Aircraft Propulsion and Power; 20 Spacecraft Propulsion and Power*, and *28 Propellants and Fuels*.

45 Environment Pollution 19

Includes atmospheric, water, soil, noise, and thermal pollution.

46 Geophysics 20

Includes earth structure and dynamics, aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism. For related information see *47 Meteorology and Climatology;* and *93 Space Radiation*.

47 Meteorology and Climatology 21

Includes weather observation forecasting and modification.

48 Oceanography N.A.

Includes the physical, chemical and biological aspects of oceans and seas; ocean dynamics, and marine resources. For related information see also *43 Earth Resources and Remote Sensing*.

Subject Categories of the Division F. Life Sciences

Select a category to view the collection of records cited. N.A. means no abstracts in that category.

51 Life Sciences (General) 21

Includes general research topics related to plant and animal biology (non–human); ecology; microbiology; and also the origin, development, structure, and maintenance, of animals and plants in space and related environmental conditions. For specific topics in life sciences see *categories 52 through 55*.

52 Aerospace Medicine 23

Includes the biological and physiological effects of atmospheric and space flight (weightlessness, space radiation, acceleration, and altitude stress) on the human being; and the prevention of adverse effects on those environments. For psychological and behavioral effects of aerospace environments see *53 Behavioral Science*. For the effects of space on animals and plants see *51 Life Sciences*.

53 Behavioral Sciences N.A.

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

54 Man/System Technology and Life Support 24

Includes human factors engineering; bionics, man–machine, life support, space suits and protective clothing. For related information see also *16 Space Transportation* and *52 Aerospace Medicine*..

55 Exobiology N.A.

Includes astrobiology; planetary biology; and extraterrestrial life. For the biological effects of aerospace environments on humans see *52 Aerospace medicine*; on animals and plants see *51 Life Sciences*. For psychological and behavioral effects of aerospace environments see *53 Behavioral Science*.

Subject Categories of the Division G. Mathematical and Computer Sciences

Select a category to view the collection of records cited. N.A. means no abstracts in that category.

59 Mathematical and Computer Sciences (General) 26

Includes general topics and overviews related to mathematics and computer science. For specific topics in these areas see *categories 60 through 67*.

60 Computer Operations and Hardware 27

Includes hardware for computer graphics, firmware and data processing. For components see *33 Electronics and Electrical Engineering*. For computer vision see *63 Cybernetics, Artificial Intelligence and Robotics*.

61 Computer Programming and Software 27

Includes software engineering, computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM. For computer software applied to specific applications, see also the associated category.

62 Computer Systems N.A.

Includes computer networks and distributed processing systems. For information systems see *82 Documentation and Information Science*. For computer systems applied to specific applications, see the associated category.

63 Cybernetics, Artificial Intelligence and Robotics 28

Includes feedback and control theory, information theory, machine learning, and expert systems. For related information see also *54 Man/System Technology and Life Support.*

64 Numerical Analysis 29

Includes iteration, differential and difference equations, and numerical approximation.

65 Statistics and Probability 30

Includes data sampling and smoothing; Monte Carlo method; time series and analysis; and stochastic processes.

66 Systems Analysis and Operations Research 41

Includes mathematical modeling of systems; network analysis; mathematical programming; decision theory; and game theory.

67 Theoretical Mathematics N.A.

Includes algebra, functional analysis, geometry, topology set theory, group theory and and number theory.

Subject Categories of the Division H. Physics

Select a category to view the collection of records cited. N.A. means no abstracts in that category.

70 Physics (General) N.A.

Includes general research topics related to mechanics, kinetics, magnetism, and electrodynamics. For specific areas of physics see *categories 71 through 77*. For related instrumentation see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics*.

71 Acoustics N.A.

Includes sound generation, transmission, and attenuation. For noise pollution see *45 Environment Pollution.* For aircraft noise see also *02 Aerodynamics* and *07 Aircraft Propulsion Propulsion and Power.*

72 Atomic and Molecular Physics N.A.

Includes atomic and molecular structure, electron properties, and atomic and molecular spectra. For elementary particle physics see *73 Nuclear Physics*.

73 Nuclear Physics 42

Includes nuclear particles; and reactor theory. For space radiation see *93 Space Radiation*. For atomic and molecular physics see *72 Atomic and Molecular Physics*. For elementary particle physics see *77 Physics of Elementary Particles and Fields*. For nuclear astrophysics see *90 Astrophysics*.

74 Optics N.A.

Includes light phenomena and the theory of optical devices. For lasers see *36 Lasers and Masers*.

75 Plasma Physics 44

Includes magnetohydrodynamics and plasma fusion. For ionospheric plasmas see *46 Geophysics.* For space plasmas see *90 Astrophysics*.

76 Solid-State Physics N.A.

Includes condensed matter physics, crystallography, and superconductivity. For related information see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers*.

77 Physics of Elementary Particles and Fields N.A.

Includes quantum mechanics; theoretical physics; and statistical mechanics. For related information see also *72 Atomic and Molecular Physics, 73 Nuclear Physics, and 25 Inorganic, Organic and Physical Chemistry.*

Subject Categories of the Division I. Social and Information Sciences

Select a category to view the collection of records cited. N.A. means no abstracts in that category.

80 Social Sciences (General) N.A.

Includes general research topics related to sociology; educational programs and curricula.

81 Administration and Management 44

Includes management planning and research.

82 Documentation and Information Science 47

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography. For computer documentation see *61 Computer Programming and Software*.

83 Economics and Cost Analysis N.A.

Includes cost effectiveness studies.

84 Law, Political Science and Space Policy 48

Includes: aviation law; space law and policy; international law; international cooperation; and patent policy.

85 Technology Utilization and Surface Transportation 49

Includes aerospace technology transfer; urban technology; surface and mass transportation. For related information see *03 Air Transportation and Safety, 16 Space Transportation and Safety*, and *44 Energy Production and Conversion.* For specific technology transfer applications see also the category where the subject is treated.

Subject Categories of the Division J. Space Sciences

Select a category to view the collection of records cited. N.A. means no abstracts in that category.

88 Space Sciences (General) N.A.

Includes general research topics related to the natural space sciences. For specific topics in Space Sciences see *categories 89 through 93*.

89 Astronomy N.A.

Includes observations of celestial bodies, astronomical instruments and techniques; radio, gamma-ray, x–ray, ultraviolet, and infrared astronomy; and astrometry.

90 Astrophysics 49

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.

91 Lunar and Planetary Science and Exploration N.A.

Includes planetology; selenology; meteorites; comets; and manned and unmanned planetary and lunar flights. For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance*.

92 Solar Physics N.A.

Includes solar activity, solar flares, solar radiation and sunspots. For related information see *93 Space Radiation.*

93 Space Radiation N.A.

Includes cosmic radiation; and inner and outer Earth radiation belts. For biological effects of radiation on plants and animals see *52 Aerospace Medicine*. For theory see *73 Nuclear Physics.*

Subject Categories of the Division K. General

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99 General 50

Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs such as Apollo, Gemini, and Mercury spacecraft, Earth Resources Technology Satellite (ERTS), and Skylab; NASA appropriations hearings.

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❶ **19970001126** NASA Langley Research Center, Hampton, VA USA
❷ **Water Tunnel Flow Visualization Study Through Poststall of 12 Novel Planform Shapes**
❸ Gatlin, Gregory M., NASA Langley Research Center, USA Neuhart, Dan H., Lockheed Engineering and Sciences Co., USA; ❹ Mar. 1996; 130p; In English
❺ Contract(s)/Grant(s): RTOP 505-68-70-04
❻ Report No(s): NASA-TM-4663; NAS 1.15:4663; L-17418; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche
❼ To determine the flow field characteristics of 12 planform geometries, a flow visualization investigation was conducted in the Langley 16- by 24-Inch Water Tunnel. Concepts studied included flat plate representations of diamond wings, twin bodies, double wings, cutout wing configurations, and serrated forebodies. The off-surface flow patterns were identified by injecting colored dyes from the model surface into the free-stream flow. These dyes generally were injected so that the localized vortical flow patterns were visualized. Photographs were obtained for angles of attack ranging from 10' to 50', and all investigations were conducted at a test section speed of 0.25 ft per sec. Results from the investigation indicate that the formation of strong vortices on highly swept forebodies can improve poststall lift characteristics; however, the asymmetric bursting of these vortices could produce substantial control problems. A wing cutout was found to significantly alter the position of the forebody vortex on the wing by shifting the vortex inboard. Serrated forebodies were found to effectively generate multiple vortices over the configuration. Vortices from 65' swept forebody serrations tended to roll together, while vortices from 40' swept serrations were more effective in generating additional lift caused by their more independent nature.
❽ Author
❾ *Water Tunnel Tests; Flow Visualization; Flow Distribution; Free Flow; Planforms; Wing Profiles; Aerodynamic Configurations*

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03
AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; aircraft ground operations; flight safety and hazards; and aircraft accidents. Systems and hardware specific to ground operations of aircraft and to airport construction are covered in 09 Research and Support Facilities (Air). Air traffic control is covered in 04 Aircraft Communications and Navigation. For related information see also 16 Space Transportation and Safety; and 85 Technology Utilization and Surface Transportation.

19900039176
Probabilistic risk assessment and aviation system safety
Wojcik, Leonard A., Flight Safety Foundation, USA; Jan 1, 1989; 6p; In English; 5th; International Symposium on Aviation Psychology, Apr. 17-20, 1989, Columbus, OH, USA; See also A90-26176; Avail: Issuing Activity

The development of safety indicators for the U.S. air transportation system is examined. Particular attention is given to quantitative indicators based on probabilistic risk assessment and the use of management and organizational factors to handle human performance issues in risk assessment. The three safety goals of the study are: (1) low frequency of accidents and incidents; (2) adequate capability to meet demand; and (3) limited potential for serious human error. The model requirements for an air traffic system based on risk assessment are discussed.
AIAA
Air Transportation; Flight Safety; Safety Factors; Safety Management

19900066057 Transportation Systems Center, Cambridge, MA, USA
Hazard analysis of commerical space transportation. Volume 3: Risk analysis
May 1, 1988; 113p; In English; Prepared in cooperation with Department of Transportation, Washington, DC; Avail: CASI; A06, Hardcopy, Unavail. Microfiche

No abstract.
Failure Modes; Flight Hazards; Probability Theory; Risk; Space Commercialization; Space Transportation; Spacecraft Reliability

19980210315 Brookhaven National Lab., Upton, NY USA
On the safety of aircraft systems: A case study
Martinez–Guridi, G., Brookhaven National Lab., USA; Hall, R. E., Brookhaven National Lab., USA; Fullwood, R. R., Brookhaven National Lab., USA; May 14, 1997; 45p; In English
Contract(s)/Grant(s): DE-AC02-76CH-00016; 95-G-039
Report No.(s): BNL-64946; DE98-002766; No Copyright; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Hardcopy, Microfiche

An airplane is a highly engineered system incorporating control- and feedback-loops which often, and realistically, are non-linear because the equations describing such feedback contain products of state variables, trigonometric or square-root functions, or other types of non-linear terms. The feedback provided by the pilot (crew) of the airplane also is typically non-linear because it has the same mathematical characteristics. An airplane is designed with systems to prevent and mitigate undesired events. If an undesired triggering event occurs, an accident may process in different ways depending on the effectiveness of such systems. In addition, the progression of some accidents requires that the operating crew take corrective action(s), which may modify the configuration of some systems. The safety assessment of an aircraft system typically is carried out using ARP (Aerospace Recommended Practice) 4761 (SAE, 1995) methods, such as Fault Tree Analysis (FTA) and Failure Mode and Effects Analysis (FMEA). Such methods may be called static because they model an aircraft system on its nominal configuration during

a mission time, but they do not incorporate the action(s) taken by the operating crew, nor the dynamic behavior (non-linearities) of the system (airplane) as a function of time. Probabilistic Safety Assessment (PSA), also known as Probabilistic Risk Assessment (PRA), has been applied to highly engineered systems, such as aircraft and nuclear power plants. PSA encompasses a wide variety of methods, including event tree analysis (ETA), FTA, and common-cause analysis, among others. PSA should not be confused with ARP 4761's proposed PSSA (Preliminary System Safety Assessment); as its name implies, PSSA is a preliminary assessment at the system level consisting of FTA and FMEA.
DOE
Failure Analysis; Safety Factors; Feedback Control; Aeronautics

04
AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes all modes of communication with and between aircraft; air navigation systems (satellite and ground based); and air traffic control. For related information see also 06 Avionics and Aircraft Instrumentation; 17 Space Communications; Spacecraft Communications, Command and Tracking, and 32 Communications and Radar.

19720029081
Selection of the optimal course as a decisional problem under risk conditions ***La scelta della rotta ottimale come problema di decisione in condizioni di rischio***
Palmieri, S.; Finizio, C.; Riccucci, A., Aeronautica Militare, Italy; Jun 1, 1971; 38p; In Italian; Associazione Elettrotecnica ed Elettronica Italiana, Simposio su Radioaiuti alla Navigazione Marittima e Aerea, June 24-26, 1971, Trieste, Italy; Sponsored by Associazione Elettrotecnica ed Elettronica Italiana; Avail: Issuing Activity

This problem is set up from a probabilistic standpoint. The manner in which forecast errors in meteorologic data affect the run times of possible courses is investigated. The probabilities that flight times be encompassed within appropriate intervals are determined by a Monte Carlo method. The optimal course construed as the course which maximizes the operating profit is determined by the appropriate definition of the payments corresponding to the possible alternatives.
AIAA
Decision Theory; Error Analysis; Probability Theory; Risk; Trajectory Optimization

12
ASTRONAUTICS (GENERAL)

Includes general research topics related to space flight and manned and unmanned space vehicles, platforms or objects launched into, or assembled in, outer space; and related components and equipment. Also includes manufacturing and maintenance of such vehicles or platforms. For specific topics in astronautics see categories 13 through 20. For extraterrestrial exploration, see 91 Lunar and Planetary Science and Exploration.

19930039060 NASA, Washington, DC, USA
Risk management for the Space Exploration Initiative
Buchbinder, Ben, NASA Washington, USA; Jan 1, 1993, pp. 6 p.; In English; 31st; AIAA, Aerospace Sciences Meeting and Exhibit, Jan. 11-14, 1993, Reno, NV, USA; Sponsored by AIAA
Report No.(s): AIAA PAPER 93-0377; Copyright; Avail: Issuing Activity

Probabilistic Risk Assessment (PRA) is a quantitative engineering process that provides the analytic structure and decision-making framework for total programmatic risk management. Ideally, it is initiated in the conceptual design phase and used throughout the program life cycle. Although PRA was developed for assessment of safety, reliability, and availability risk, it has far greater application. Throughout the design phase, PRA can guide trade-off studies among system performance, safety, reliability, cost, and schedule. These studies are based on the assessment of the risk of meeting each parameter goal, with full consideration of the uncertainties. Quantitative trade-off studies are essential, but without full identification, propagation, and display of uncertainties, poor decisions may result. PRA also can focus attention on risk drivers in situations where risk is too high. For example, if safety risk is unacceptable, the PRA prioritizes the risk contributors to guide the use of resources for risk mitigation. PRA is used in the Space Exploration Initiative (SEI) Program. to meet the stringent requirements of the SEI mission,

within strict budgetary constraints, the PRA structure supports informed and traceable decision-making. This paper briefly describes the SEI PRA process.
AIAA
Aerospace Engineering; Management Methods; Risk

19930047032
Risk-based spacecraft fire safety experiments
Paulos, T.; Paxton, K.; Jones, S.; Issacci, F.; Catton, I.; Apostolakis, G., California Univ., USA; Feb 1, 1993, pp. 10 p.; In English; AIAA, AHS, and ASEE, Aerospace Design Conference, Feb. 16-19, 1993, Irvine, CA, USA; Sponsored by AIAA
Report No.(s): AIAA PAPER 93-1153; Copyright; Avail: Issuing Activity

This paper discusses how Probabilistic Risk Assessment (PRA) can be used as a tool in selecting spacecraft fire safety experiments. Microgravity testing is costly and time consuming; a methodology is needed so that useful knowledge can be gained in the limited testing available. Since the total number of possible fire scenarios in a habitable spacecraft is quite large, PRA becomes a useful tool in determining the more likely fire scenarios, which can then be studied in microgravity tests.
AIAA
Fire Prevention; Microgravity; Risk; Safety Factors; Space Stations

19980215043
Cassini Mission probabilistic risk analysis: comparison of two probabilistic dynamic methodologies
Swaminathan, S., Univ. of Maryland, USA; Van–Halle, J. –Y.; Smidts, C.; Mosleh, A.; Bell, S.; Rudolph, K.; Mulvihill, R. J.; Bream, B.; Reliability Engineering & System Safety; Oct, 1997; ISSN 0951-8320; Volume 58, no. 1, pp. 1-14; In English; Copyright; Avail: Issuing Activity

This paper describes a comparison between two dynamic methodologies used in the probabilistic risk analysis (PRA) of the Cassini Mission. The main Cassini PRA was performed by Lockheed Martin. A combination of Monte Carlo algorithms and event-tree logic was used to perform the study. Results were validated using an alternative method, the Discrete Dynamic Event Tree (DDET) methodology. Two major conclusions of the paper are 1) performing a dynamic PRA of large scale 'real-life' systems is feasible and 2) given the same ground rules and assumptions, two dynamic methodologies would give the same results.
EI
Cassini Mission; Assessments; Risk; Space Flight; Safety Factors; Monte Carlo Method; Probability Theory

16
SPACE TRANSPORTATION AND SAFETY

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques. For related information, see also 03 Air Transportation and Safety and 15 Launch Vehicles and Launch Vehicles, and 18 Spacecraft Design, Testing and Performance. For space suits, see 54 Man/System Technology and Life Support.

19890001557 Lawrence Livermore National Lab., Nuclear Systems Safety Program., Livermore, CA, USA
Review of the space shuttle propulsion pressurization system probabilistic risk assessment
Wells, James E., Lawrence Livermore National Lab., USA; Johnson, Gary L., Lawrence Livermore National Lab., USA; Jun 24, 1988; 36p; In English
Contract(s)/Grant(s): W-7405-ENG-48
Report No.(s): DE88-013163; UCID-21443; Avail: CASI; A03, Hardcopy; A01, Microfiche

Lockheed Missiles and Space Company, Inc. has performed a probabilistic risk assessment of the space shuttle main propulsion pressurization system for NASA. A draft report of the assessment was completed in mid September 1987. We at the Lawerence Livermore National Laboratory (LLNL) were asked by NASA to perform an independent peer review of that risk assessment. This review assessed whether the analysis was done consistent with currently used methods for doing such analyses, pointed out deficiencies found in the analysis, and evaluated how these deficiencies affected the final result.
DOE
Assessments; Pressurizing; Propulsion; Risk; Space Shuttles

19910025514

Safety risk assessment on the Space Station Freedom

Kaplan, Stan, PLG, Inc., USA; Sep 1, 1990; 12p; In English

Report No.(s): AIAA PAPER 90-3771; Copyright; Avail: Issuing Activity

The discipline of probabilistic risk assessment (PRA), viewed as both a part of the design process and a conceptual framework for all the laboratories and contractors, is discussed with respect to the Space Station Freedom. The basic premise is that risk is a property of an engineered system just like weight, thrust, and payload capacity. A quantitative definition of risk is given; sets of scenarios are identified and structured into categories which constitute the basis of a risk model.

AIAA

Aerospace Safety; Risk; Safety Management; Space Station Freedom; Space Stations

19930029775 NASA, Washington, DC, USA

Uncertainty analysis for Ulysses safety evaluation report

Frank, Michael V., Safety Factor Associates, USA; In: Space nuclear power systems; Proceedings of the 8th Symposium, Albuquerque, NM, Jan. 6-10, 1991. Pt. 1 (A93-13751 03-20); 1991, pp. 140-145.; In English; See also A93-13751; Research supported by Interagency Nuclear Safety Review Panel and NASA; Copyright; Avail: Issuing Activity

As part of the effort to review the Ulysses Final Safety Analysis Report and to understand the risk of plutonium release from the Ulysses spacecraft General Purpose Heat Source-Radioisotope Thermal Generator, the Interagency Nuclear Safety Review Panel (INSRP) performed an integrated, quantitative analysis of the uncertainties of the calculated risk of plutonium release from Ulysses. Using state-of-art probabilistic risk assessment technology, the uncertainty analysis accounted for both variability and uncertainty of the key parameters of the risk analysis. The results show that INSRP had high confidence that risk of fatal cancers from potential plutonium release associated with calculated launch and deployment accident scenarios is low.

AIAA

Aerospace Safety; Plutonium; Radiation Hazards; Ulysses Mission

19950019978 Science Applications International Corp., Advanced Technology Div., New York, NY, USA

Probabilistic risk assessment of the Space Shuttle. Phase 3: A study of the potential of losing the vehicle during nominal operation, volume 1 ***Final Report***

Fragola, Joseph R., Science Applications International Corp., USA; Maggio, Gaspare, Science Applications International Corp., USA; Frank, Michael V., Safety Factors Associates, Inc., USA; Gerez, Luis, Empresarios Agrupados, Spain; Mcfadden, Richard H., Science Applications International Corp., Spain; Collins, Erin P., Science Applications International Corp., Spain; Ballesio, Jorge, Science Applications International Corp., Spain; Appignani, Peter L., Science Applications International Corp., Spain; Karns, James J., Science Applications International Corp., Spain; Feb 28, 1995; 159p; In English

Contract(s)/Grant(s): NASW-4911

Report No.(s): NASA-CR-197808; NAS 1.26:197808; SAICNY95-02-25-VOL-1; Avail: CASI; A08, Hardcopy; A02, Microfiche

This document is the Executive Summary of a technical report on a probabilistic risk assessment (PRA) of the Space Shuttle vehicle performed under the sponsorship of the Office of Space Flight of the US National Aeronautics and Space Administration. It briefly summarizes the methodology and results of the Shuttle PRA. The primary objective of this project was to support management and engineering decision-making with respect to the Shuttle program by producing (1) a quantitative probabilistic risk model of the Space Shuttle during flight, (2) a quantitative assessment of in-flight safety risk, (3) an identification and prioritization of the design and operations that principally contribute to in-flight safety risk, and (4) a mechanism for risk-based evaluation proposed modifications to the Shuttle System. Secondary objectives were to provide a vehicle for introducing and transferring PRA technology to the NASA community, and to demonstrate the value of PRA by applying it beneficially to a real program of great international importance.

Derived from text

Assessments; Flight Safety; NASA Programs; Risk; Safety Factors; Space Shuttles

19950019979 Science Applications International Corp., Advanced Technology Div., New York, NY, USA

Probabilistic risk assessment of the Space Shuttle. Phase 3: A study of the potential of losing the vehicle during nominal operation. Volume 2: Integrated loss of vehicle model

Fragola, Joseph R., Science Applications International Corp., USA; Maggio, Gaspare, Science Applications International Corp., USA; Frank, Michael V., Safety Factors Associates, Inc., USA; Gerez, Luis, Empresarios Agrupados, Spain; Mcfadden, Richard H., Science Applications International Corp., Spain; Collins, Erin P., Science Applications International Corp., Spain; Ballesio,

Jorge, Science Applications International Corp., Spain; Appignani, Peter L., Science Applications International Corp., Spain; Karns, James J., Science Applications International Corp., Spain; Feb 28, 1995; 581p; In English
Contract(s)/Grant(s): NASW-4911
Report No.(s): NASA-CR-197809; NAS 1.26:197809; SAICNY95-02-25-VOL-2; Avail: CASI; A25, Hardcopy; A06, Microfiche

The application of the probabilistic risk assessment methodology to a Space Shuttle environment, particularly to the potential of losing the Shuttle during nominal operation is addressed. The different related concerns are identified and combined to determine overall program risks. A fault tree model is used to allocate system probabilities to the subsystem level. The loss of the vehicle due to failure to contain energetic gas and debris, to maintain proper propulsion and configuration is analyzed, along with the loss due to Orbiter, external tank failure, and landing failure or error.
CASI
Aerospace Safety; Assessments; Probability Theory; Risk; Space Shuttles; Spacecraft Reliability

19950019980 Science Applications International Corp., Advanced Technology Div., New York, NY, USA
Probabilistic risk assessment of the Space Shuttle. Phase 3: A study of the potential of losing the vehicle during nominal operation. Volume 3: Basic events and minimal cutsets
Fragola, Joseph R., Science Applications International Corp., USA; Maggio, Gaspare, Science Applications International Corp., USA; Frank, Michael V., Safety Factors Associates, Inc., USA; Gerez, Luis, Empresarios Agrupados, Spain; Mcfadden, Richard H., Science Applications International Corp., Spain; Collins, Erin P., Science Applications International Corp., Spain; Ballesio, Jorge, Science Applications International Corp., Spain; Appignani, Peter L., Science Applications International Corp., Spain; Karns, James J., Science Applications International Corp., Spain; Feb 28, 1995; 357p; In English
Contract(s)/Grant(s): NASW-4911
Report No.(s): NASA-CR-197810; NAS 1.26:197810; SAICNY95-02-25-VOL-3; Avail: CASI; A16, Hardcopy; A03, Microfiche

In Volume 3 of Phase 3 of the Space Shuttle Probabilistic Risk Assessment, the basic events database and minimal cutsets are presented, along with their predicted probability in tabular form.
CASI
Damage Assessment; Performance Prediction; Risk; Space Shuttles

19950019981 Science Applications International Corp., Advanced Technology Div., New York, NY, USA
Probabilistic risk assessment of the Space Shuttle. Phase 3: A study of the potential of losing the vehicle during nominal operation. Volume 4: System models and data analysis
Fragola, Joseph R., Science Applications International Corp., USA; Maggio, Gaspare, Science Applications International Corp., USA; Frank, Michael V., Safety Factors Associates, Inc., USA; Gerez, Luis, Empresarios Agrupados, Spain; Mcfadden, Richard H., Science Applications International Corp., Spain; Collins, Erin P., Science Applications International Corp., Spain; Ballesio, Jorge, Science Applications International Corp., Spain; Appignani, Peter L., Science Applications International Corp., Spain; Karns, James J., Science Applications International Corp., Spain; Feb 28, 1995; 435p; In English
Contract(s)/Grant(s): NASW-4911
Report No.(s): NASA-CR-197811; NAS 1.26:197811; SAICNY95-02-25-VOL-4; Avail: CASI; A19, Hardcopy; A04, Microfiche

In this volume, volume 4 (of five volumes), the discussion is focussed on the system models and related data references and has the following subsections: space shuttle main engine, integrated solid rocket booster, orbiter auxiliary power units/hydraulics, and electrical power system.
CASI
Auxiliary Power Sources; Electric Power; Failure Analysis; Risk; Space Shuttle Boosters; Space Shuttle Main Engine; Space Shuttles

19950019983 Science Applications International Corp., Advanced Technology Div., New York, NY, USA
Probabilistic risk assessment of the Space Shuttle. Phase 3: A study of the potential of losing the vehicle during nominal operation. Volume 5: Auxiliary shuttle risk analyses
Fragola, Joseph R., Science Applications International Corp., USA; Maggio, Gaspare, Science Applications International Corp., USA; Frank, Michael V., Safety Factors Associates, Inc., USA; Gerez, Luis, Empresarios Agrupados, Spain; Mcfadden, Richard H., Science Applications International Corp., Spain; Collins, Erin P., Science Applications International Corp., Spain; Ballesio, Jorge, Science Applications International Corp., Spain; Appignani, Peter L., Science Applications International Corp., Spain;

Karns, James J., Science Applications International Corp., Spain; Feb 28, 1995; 1036p; In English
Contract(s)/Grant(s): NASW-4911
Report No.(s): NASA-CR-197812; NAS 1.26:197812; SAICNY95-02-25-VOL-5; Avail: CASI; A99, Hardcopy; A10, Microfiche

Volume 5 is Appendix C, Auxiliary Shuttle Risk Analyses, and contains the following reports: Probabilistic Risk Assessment of Space Shuttle Phase 1 - Space Shuttle Catastrophic Failure Frequency Final Report; Risk Analysis Applied to the Space Shuttle Main Engine - Demonstration Project for the Main Combustion Chamber Risk Assessment; An Investigation of the Risk Implications of Space Shuttle Solid Rocket Booster Chamber Pressure Excursions; Safety of the Thermal Protection System of the Space Shuttle Orbiter - Quantitative Analysis and Organizational Factors; Space Shuttle Main Propulsion Pressurization System Probabilistic Risk Assessment, Final Report; and Space Shuttle Probabilistic Risk Assessment Proof-of-Concept Study - Auxiliary Power Unit and Hydraulic Power Unit Analysis Report.
CASI
Probability Theory; Reliability Analysis; Risk; Space Shuttle Boosters; Space Shuttle Main Engine; Space Shuttle Orbiters; Space Shuttles; Spacecraft Reliability; System Failures; Thermal Protection

19980048419 NASA Marshall Space Flight Center, Huntsville, AL USA
Methods and Techniques for Risk Prediction of Space Shuttle Upgrades
Hoffman, Chad R., Pratt and Whitney Aircraft, USA; Pugh, Rich, Pratt and Whitney Aircraft, USA; Safie, Fayssal, NASA Marshall Space Flight Center, USA; 1998; 11p; In English, 20-23 Apr. 1998, Long Beach, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): NASA/TM-1998-207792; NAS 1.15:207792; AIAA Paper 98-1938; Copyright Waived (NASA); Avail: CASI; A03, Hardcopy; A01, Microfiche

Since the Space Shuttle Accident in 1986, NASA has been trying to incorporate probabilistic risk assessment (PRA) in decisions concerning the Space Shuttle and other NASA projects. One major study NASA is currently conducting is in the PRA area in establishing an overall risk model for the Space Shuttle System. The model is intended to provide a tool to predict the Shuttle risk and to perform sensitivity analyses and trade studies including evaluation of upgrades. Marshall Space Flight Center (MSFC) and its prime contractors including Pratt and Whitney (P&W) are part of the NASA team conducting the PRA study. MSFC responsibility involves modeling the External Tank (ET), the Solid Rocket Booster (SRB), the Reusable Solid Rocket Motor (RSRM), and the Space Shuttle Main Engine (SSME). A major challenge that faced the PRA team is modeling the shuttle upgrades. This mainly includes the P&W High Pressure Fuel Turbopump (HPFTP) and the High Pressure Oxidizer Turbopump (HPOTP). The purpose of this paper is to discuss the various methods and techniques used for predicting the risk of the P&W redesigned HPFTP and HPOTP.
Author
Risk; Predictions; Space Shuttles; NASA Programs

19980120591
Space Shuttle probabilistic risk assessment - Methodology and application
Maggio, Gaspare, Science Applications International Corp., New York, USA; 1996, pp. 121-132; In English; Copyright; Avail: Aeroplus Dispatch

This paper describes the methodology and processes used for the probabilistic risk assessment of the Space Shuttle vehicle to systematically quantify the risk incurred during a nominal Shuttle mission and rank the risk driving components to allow for a concerted risk and cost reduction effort. The fundamental approach used in this assessment of Shuttle operational risk is scenario-based and consists of quantitatively assessing the potential progression of postulated initiating events as intercepted and diverted by protective and mitigative features of the Shuttle system design. The approach implements a hierarchical model development methodology which has been found to ensure comprehensiveness and tractability by focusing the analysts' efforts on the main risk drivers. The models are quantified by performing a data analysis effort in parallel with file model development. The risk assessment database includes all Shuttle flight-relevant history, that is, precursors to flight failure and test anomalies as well as actual in flight anomalies.
Author (AIAA)
Space Shuttles; Probability Theory; Methodology; System Failures

19980120592

Space Shuttle program risk management

Fragola, Joseph R., Science Applications International Corp., New York, USA; 1996, pp. 133-142; In English; Copyright; Avail: Aeroplus Dispatch

In the decade since the Challenger accident NASA has slowly undergone a paradigm shift in its approach towards the assessment of the potential for the loss of a Shuttle vehicle and crew. A recognition by NASA management of the usefulness of probabilistic risk assessment (PRA) results in the setting of priorities in Shuttle program activities convinced the NASA Office of Space Flight and Office of Safety and Mission Assurance Associate Administrators to jointly sponsor a series of educational seminars on PRA throughout the NASA facilities. Further, they agreed to undertake a comprehensive and more detailed PRA study of the Shuttle throughout all its active mission phases from launch to wheel-stop on landing. The results of this study provide a key element in a Space Shuttle risk management program which may enable the substantial cost reductions required to keep the Shuttle program viable while maintaining the Shuttle's admirable safety and reliability record.

Author (AIAA)

Space Shuttles; Failure Modes; Failure Analysis

17
SPACE COMMUNICATIONS, SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING

Includes space systems telemetry; space communications networks; astronavigation and guidance; and spacecraft radio blackout. For related information, see also 04 Aircraft Communications and Navigation and 32 Communications and Radar.

19850060441

Protecting intellectual property in space; Proceedings of the Aerospace Computer Security Conference, McLean, VA, March 20, 1985

Jan 1, 1985; 98p; In English; Protecting intellectual property in space, March 20, 1985, McLean, VA; Sponsored by NASA, AIAA, and Mitre Corp.; Copyright; Avail: Issuing Activity

The primary purpose of the Aerospace Computer Security Conference was to bring together people and organizations which have a common interest in protecting intellectual property generated in space. Operational concerns are discussed, taking into account security implications of the space station information system, Space Shuttle security policies and programs, potential uses of probabilistic risk assessment techniques for space station development, key considerations in contingency planning for secure space flight ground control centers, a systematic method for evaluating security requirements compliance, and security engineering of secure ground stations. Subjects related to security technologies are also explored, giving attention to processing requirements of secure C3/I and battle management systems and the development of the Gemini trusted multiple microcomputer base, the Restricted Access Processor system as a security guard designed to protect classified information, and observations on local area network security.

AIAA

Aerospace Systems; Computer Information Security; Conferences; Intellectual Property; Space Communication

18
SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and spacecraft control and stability characteristics. For life support systems, see 54 Man/System Technology and Life Support. For related information, see also 05 Aircraft Design, Testing and Performance, 39 Structural Mechanics, and 16 Space Transportation and Safety.

19920002821 Interagency Nuclear Safety Review Panel., USA

Uncertainty analysis report for Ulysses, volume 1

Frank, M. V., Safety Factors Associates, USA; Jul 1, 1990; 11p; In English; Sponsored by DOE

Report No.(s): DE91-013476; INSRP-90-07-VOL-1; Avail: CASI; A03, Hardcopy; A01, Microfiche

This volume provides comments related to the Final Safety Analysis Report (FSAR) integrated risk analysis. The review encompassed the risk analysis aspects of the following FSAR sections: Executive Summary; Volume 3, Book 1, all sections; and

Volume 3, Book 2, Appendices A, B, and D. The review also included a May 23, 1990, letter from James A. Turi of the Department of Energy (DOE) to Dudley G. McConnell of NASA.
DOE
Aerospace Vehicles; Failure; Heat Sources; Probability Theory; Radiation Dosage; Risk; Thermoelectric Generators; Ulysses Mission

19930019549 California Univ., Dept. of Mechanical, Aerospace and Nuclear Engineering., Los Angeles, CA, USA
Risk-based spacecraft fire safety experiments
Apostolakis, G., California Univ., USA; Catton, I., California Univ., USA; Issacci, F., California Univ., USA; Paulos, T., California Univ., USA; Jones, S., California Univ., USA; Paxton, K., California Univ., USA; Paul, M., California Univ., USA; NASA, Washington, NASA(DOD Flight Experiments Technical Interchange Meeting Proceedings; Jan 1, 1992, pp. 11 p; In English; See also N93-28699 11-12; Sponsored by NASA. Lewis Research Center; Avail: CASI; A03, Hardcopy; A10, Microfiche

Viewgraphs on risk-based spacecraft fire safety experiments are presented. Spacecraft fire risk can never be reduced to a zero probability. Probabilistic risk assessment is a tool to reduce risk to an acceptable level.
CASI
Aerospace Safety; Fire Prevention; Fires; Probability Theory

19960025476 Pacific Univ., Physics Dept., Forest Grove, OR USA
Orbital debris removal using ground-based lasers
Taylor, Charles R., Pacific Univ., USA; Research Reports: 1995 NASA/ASEE Summer Faculty Fellowship Program; Feb. 1996; 8p; In English; See also 19960025428; No Copyright; Avail: CASI; A02, Hardcopy; A04, Microfiche

Orbiting the Earth are spent rocket stages, non-functioning satellites, hardware from satellite deployment and staging, fragments of exploded spacecraft, and other relics of decades of space exploration: orbital debris. The USA Space Command tracks and maintains a catalog of the largest objects. The catalog contains over 7000 objects. Recent studies have assessed the debris environment in an effort to estimate the number of smaller particles and the probability of a collision causing catastrophic damage to a functioning spacecraft. The results of the studies can be used to show, for example, that the likelihood of a collision of a particle larger than about one centimeter in diameter with the International Space Station during a 10-year period is a few percent, roughly in agreement with earlier estimates for Space Station Freedom. Particles greater than about one centimeter in diameter pose the greatest risk to shielded spacecraft. There are on the order of 105 such particles in low Earth orbit. The USA National Space Policy, begun in 1988, is to minimize debris consistent with mission requirements. Measures such as venting unused fuel to prevent explosions, retaining staging and deployment hardware, and shielding against smaller debris have been taken by the U.S. and other space faring nations. There is at present no program to remove debris from orbit. The natural tendency for upper atmospheric drag to remove objects from low Earth orbit is more than balanced by the increase in the number of debris objects from new launches and fragmentation of existing objects. In this paper I describe a concept under study by the Program Development Laboratory of Marshall Space Flight Center and others to remove debris with a ground-based laser. A longer version of this report, including figures, is available from the author.
Derived from text
Space Debris; Probability Theory; Risk; Mission Planning; Low Earth Orbits; Lasers

20
SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxiliary power sources. For related information, see also 07 Aircraft Propulsion and Power; 28 Propellants and Fuels; 15 Launch Vehicles and Launch Operations; and 44 Energy Production and Conversion.

19890011658 Martin Marietta Aerospace, Astronautics Group., Denver, CO, USA
Space Propulsion Hazards Analysis Manual (SPHAM), volume 1 ***Final Report, Dec. 1983 - Jun. 1986***
Erdahl, David C., Martin Marietta Aerospace, USA; Banning, Douglas W., Martin Marietta Aerospace, USA; Simon, Elvis D., Martin Marietta Aerospace, USA; Oct 1, 1988; 501p; In English
Contract(s)/Grant(s): F04611-84-C-0003

Report No.(s): AD-A203204; MCR-88-590-VOL-1; AFAL-TR-88-096-VOL-1; Avail: CASI; A22, Hardcopy; A04, Microfiche

SPHAM is a compilation of methods and data directed at hazards analysis and safety for space propulsion and associated vehicles, but broadly applicable to other environments and systems. It includes methods for compiling imposed requirements and deriving design requirements. It describes in detail the steps to constructing accident scenarios for formal risk assessment. It discusses the approaches the developing probabilities for events in scenarios, and probabilities for scenarios. It illustrates data anlaysis from experience data for the purpose of probability modeling. The SPHAM provides methods for predicting blast, fragmentation, thermal, acoustic and toxicity post-accident environments. SPHAM describes in overview fashion a large number of qualitative and quantitative analytical methods available to perform hazards analysis complete with guidelines for application. Examples are FMEA, Fault-tree and Energy Analysis. It describes methods to organize analysis by type, phase, or subsystem. Examples are interface hazards analysis, preliminary hazards analysis, and ordnance hazards analysis. Qualitative and quantitative risk assessments are described. The formal processes for hazards analysis and safety for various agencies and departments of the government and DOD are described. The appendices to SPHAM contain voluminous data on available references in the form of an annotated bibliography, summary of the hazardous nature of 27 commodities common the space propulsion, and system descriptions for a variety of space vehicles, upper stage vehicles, and spacecraft.

DTIC

Accidents; Hazards; Launch Vehicles; Mathematical Models; Probability Theory; Risk; Space Flight; Spacecraft Propulsion

19900055157

A probabilistic risk assessment for the Space Shuttle Main Engine with a turbomachinery vibration monitor cutoff system

Biggs, R. E., Rockwell International Corp., USA; Jul 1, 1990; 15p; In English

Report No.(s): AIAA PAPER 90-2712; Copyright; Avail: Issuing Activity

A model has been developed using quantitative probabilistic risk assessment that identifies and quantifies all the different related concerns and combines them in a manner appropriate to the determination of overall program risks. A mathematical procedure (failure fraction method) is shown that permits the downward allocation of system probabilities to the subsystem level. This mathematical method is used to anchor the analysis to the observed engine reliability while projecting subsystem failure rates consistent with previously known distributions. The desirability of expanding the number of flight monitors to include vibration monitoring for the two high pressure turbopumps is also examined.

AIAA

Risk; Shutdowns; Space Shuttle Main Engine; Spacecraft Reliability

19920029963

Risk analysis of an RTG on the Space Shuttle

Frank, Michael V., Safety Factor Associates, USA; Oct 1, 1991; 8p; In English

Report No.(s): IAF PAPER 91-239; Copyright; Avail: Issuing Activity

As part of the effort to review the Ulysses Final Safety Analysis Report and to understand the risk of plutonium release from the Ulysses spacecraft General Purpose Heat Source-Radioisotope Thermal Generator (GPHS-RTG), the Interagency Nuclear Safety Review Panel (INSRP) and the author performed an integrated, quantitative analysis of the uncertainties of the calculated risk of plutonium release from Ulysses. Using state-of-the-art probabilistic risk assessment technology, the uncertainty analysis accounted for both variability and uncertainty of the key parameters of the risk analysis. The results show tht INSRP had high confidence that risk of fatal cancers from potential plutonium release associated with calculated launch and deployment accident scenarios is low.

AIAA

Radiation Hazards; Risk; Space Shuttle Payloads; Ulysses Mission

19980138178

Risk-based evaluation of launch vehicle propulsion system designs

Maggio, G., Science Applications International Corp., New York, USA; Gerez, L., IberEspacio, S.A., Spain; Jul. 1996; In English

Report No.(s): AIAA Paper 96-3229; Copyright; Avail: AIAA Dispatch

Risk evaluation methodologies that are traditionally used in the aerospace industry are briefly reviewed. The concept of probabilistic risk assessment (PRA) is then presented, and its implementation for the Space Shuttle is demonstrated. It is noted that applying risk-based methods to future propulsion systems may assist in identifying not only critical flaws in the design which

could cause catastrophic failures but also helps focus attention on potential reliability enhancing attributes. Associating cost estimates with possible consequences of various functional failures also offers a method for comparing the cost of design modifications with savings that may be expected due to better operability.
AIAA
Launch Vehicles; Propulsion System Configurations; Systems Engineering

24
COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

19800020931 George Washington Univ., School of Engineering and Applied Science., Washington, DC, USA
Statistical aspects of carbon fiber risk assessment modeling
Gross, D., George Washington Univ., USA; Miller, D. R., George Washington Univ., USA; Soland, R. M., George Washington Univ., USA; Jul 1, 1980; 127p; In English
Contract(s)/Grant(s): NSG-1556
Report No.(s): NASA-CR-159318; Avail: CASI; A07, Hardcopy; A02, Microfiche

The probabilistic and statistical aspects of the carbon fiber risk assessment modeling of fire accidents involving commercial aircraft are examined. Three major sources of uncertainty in the modeling effort are identified. These are: (1) imprecise knowledge in establishing the model; (2) parameter estimation; and (3)Monte Carlo sampling error. All three sources of uncertainty are treated and statistical procedures are utilized and/or developed to control them wherever possible.
A.R.H.
Carbon Fibers; Fires; Mathematical Models; Probability Theory; Risk; Statistical Analysis

31
ENGINEERING (GENERAL)

Includes general research topics to engineering and applied physics, and particular areas of vacuum technology, industrial engineering, cryogenics, and fire prevention. For specific topics in engineering see categories 32 through 39.

19850026012 National Bureau of Standards, National Engineering Laboratory., Gaithersburg, MD, USA
The application of models to the assessment of fire hazard from consumer products
Bukowski, R. W., National Bureau of Standards, USA; Aug 1, 1985; 31p; In English
Report No.(s): NBSIR-85-3219; Avail: CASI; A03, Hardcopy; A01, Microfiche

The differences among models of fire, fire hazard, and fire risk are described. The use of field, zone, and network models for fire hazard assessment is discussed. A number of available single and multiple compartment models are described. Key considerations with respect to the use of the current models by the Consumer Product Safety Commission for hazard assessment from upholstered furniture and mattress fires is presented. Modifications necessary to improve the capability of these models for hazard assessments are identified. Model validation, output presentation, and data sources are discussed. Recommendations on specific models for the sponsor to consider for further study and use are provided.
CASI
Combustion; Fires; Fluid Flow; Hazards; Heat Transfer; Probability Theory; Risk

19890037474
Risk assessment for safety
Hadlock, Charles R.; Glaser, Peter E., Arthur D. Little, Inc., USA; Jan 1, 1988; 6p; In English; See also A89-24844 08-12
Report No.(s): IAF PAPER 86-59B; Copyright; Avail: Issuing Activity

The application of probabilistic risk-assessment techniques to space missions is discussed, with a focus on the International Space Station. The types of hazards likely to be caused by random events; design, operational, and management errors; and intentional intervention are examined along with their secondary effects; and the top-level safety requirements defined by NASA are considered. It is suggested that such qualitative stipulations be supplemented with more quantitative measures such as used in the nuclear-power industry; the major features of such quantitative methods are reviewed.
AIAA
Aerospace Safety; Mission Planning; Risk; Space Stations

19920009372 European Space Agency. European Space Research and Technology Center, Product Assurance and Safety Dept., ESTEC, Noordwijk, Netherlands

Safety risk assessment for ESA space programmes

Preyssl, C., European Space Agency. European Space Research and Technology Center, Netherlands; Panicucci, M., European Space Agency. European Space Research and Technology Center, Netherlands; Peltonen, P., European Space Agency. European Space Research and Technology Center, Netherlands; Space Product Assurance for Europe in the 1990s: An ESA Symposium; Aug 1, 1991, pp. p 43-49; In English; See also N92-18607 09-31; Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

Risk assessment in the probabilistic evaluation of accident scenarios is discussed. The methodology involves the determination and propagation of event probabilities to calculate risk as a function of consequence severity and probability. Expert judgement is used in a structured way. Risk assessment results are used for the prioritization and optimization of risk reduction efforts and allocation of resources.

ESA

Accident Prevention; Assessments; Probability Theory; Resource Allocation; Risk; Safety Management

19930021319 Sandia National Labs., Albuquerque, NM, USA

Steps required in the pursuit of quantitative risk management processes for high pressure systems

Priddy, T. G., Sandia National Labs., USA; Jul 1, 1993; 12p; In English; Pressure Vessel and Piping Conference, 25-29 Jul. 1993, Denver, CO, USA

Contract(s)/Grant(s): DE-AC04-76DP-00789

Report No.(s): DE93-007586; SAND-93-0170C; CONF-930702-11; Avail: CASI; A03, Hardcopy; A01, Microfiche

Codes and standards have served remarkably well in reducing both the frequency and the consequences of pressure vessel and piping system failures. Past successful uses of safety standards show that safety can indeed be designed into potentially hazardous systems. Operational maintenance and inspection programs can also ensure and perpetuate design and manufactured reliability. However, as more advanced and challenging applications with high pressure systems and potentially hazardous operations are encountered, it is necessary to sharpen our technology, estimate reliability, quantify consequences, and manage risks with cost-effective processes. Practical systems are constructed of several components, and design standards are not always available for every component. A variable level of safety is, therefore, admitted within a system and some assessment of the overall safety is desired. Additionally, when potential personnel safety consequences are large but isolated, secondary protective steps should be considered such as barricading, protective enclosures, or remote operation. Rationale and activities that are based on probabilistic risk assessment (PRA) methods are discussed. While general application of PRA is not advocated at this time, certain derivative parts are suggested for use in closed-loop, risk management activities.

DOE

Pressure Vessels; Probability Theory; Reliability Engineering; Risk; Safety Management

19940018527 Sandia National Labs., Albuquerque, NM, USA

Development and experimental validation of computational methods to simulate abnormal thermal and structural environments

Moya, J. L., Sandia National Labs., USA; Skocypec, R. D., Sandia National Labs., USA; Thomas, R. K., Sandia National Labs., USA; Jan 1, 1993; 13p; In English; Surety Technology Symposium, 28 Sep. - 2 Oct. 1993, Chelyacinsk, Russia

Contract(s)/Grant(s): DE-AC04-76DP-00789

Report No.(s): DE94-000554; SAND-93-2215C; CONF-9309215-3; Avail: CASI; A03, Hardcopy; A01, Microfiche

Over the past 40 years, Sandia National Laboratories (SNL) has been actively engaged in research to improve the ability to accurately predict the response of engineered systems to abnormal thermal and structural environments. These engineered systems contain very hazardous materials. Assessing the degree of safety/risk afforded the public and environment by these engineered systems, therefore, is of upmost importance. The ability to accurately predict the response of these systems to accidents (to abnormal environments) is required to assess the degree of safety. Before the effect of the abnormal environment on these systems can be determined, it is necessary to ascertain the nature of the environment. Ascertaining the nature of the environment, in turn, requires the ability to physically characterize and numerically simulate the abnormal environment. Historically, SNL has demonstrated the level of safety provided by these engineered systems by either of two approaches: a purely regulatory approach, or by a probabilistic risk assessment (PRA). This paper will address the latter of the two approaches.

DOE

Aircraft Accidents; Aircraft Safety; Computerized Simulation; Crashes; Dynamic Structural Analysis; Fires; Thermal Environments

19960037680

Calculating exact top-event probabilities using Sigma Pi -Patrec

Heger, A. Sharif, Univ of New Mexico, USA; Bhat, Jayaram K.; Stack, Desmond W.; Talbott, Dale V.; IEEE Transactions on Reliability; December 1995; ISSN 0018-9529; 44, 4, pp. 640-644; In English; Copyright; Avail: Issuing Activity

A method for calculating top-event exact probabilities, which combines Corynen's Sigma Pi algorithm and the pattern recognition scheme of Koen et al., is presented. Sigma Pi -Patrec, a program developed using this method, computes the top-event exact probability of a system fault-tree model as defined by its cut sets. The Sigma Pi module partitions and disjoints the cut sets and solves the resultant sub-models recursively. The pattern recognition module reduces the computational complexity by recognizing repeated sub-models in the calculation process, thus avoiding repeated evaluations. Sigma Pi -Patrec is designed to quantify the fault-tree models of coherent and incoherent systems, and interfaces with the graphic package SEATREE for interactive generation of fault trees.

Author (EI)

Algorithms; Applications Programs (Computers); Assessments; Computation; Computer Programs; Fault Trees; Pattern Recognition; Probability Theory; Risk

19980004307

Focused hierarchial approach to PSA validation and PSA applications

Hackerott, Alan, Omaha Public Power District, USA; Mrowca, Bruce; Schneider, Raymond E.; Jaquith, Susan C.; American Society of Mechanical Engineers, Pressure Vessels and Piping Division (Publication) PVP. Risk-Informed Decision Making; 1997; ISSN 0277-027X; Volume 358, pp. 93-97; In English; 1997 ASME Pressure Vessels and Piping Conference, Jul. 27-31, 1997, Orlando, FL, USA; Copyright; Avail: Issuing Activity

Over the past several years, the CEOG has established a structure for the joint application and validation of member utility PSAs. The PSAWG validation effort consists of a multi phased, applications driven process. The process is evolutionary, in that it recognizes that PSAs are living, and that experience in using and understanding the tool is fundamental to the long term success of PSA. The PSAWG approach is application driven, in that many important applications can be addressed by the current PSAs, provided the application related PSA issues are adequately assessed. The structure for application validation includes (1) application specific cross-comparisons/assessments (2) global comparisons/assessments of PSA inputs, assumptions and modeling techniques (3) formulation of technical position papers and application guidelines and (4) peer review. This effort encourages member utilites to identify, assess and resolve differences among the CEOG member utility PSAs, in general, and with regard to specific applications in particular. In addition, the CEOG effort allows members to share insights, and upgrade their PSA model to address common technical issues. This process is evolving into a coherent basis for the validation, certification and application of PSAs. This paper provides an overview of the CEOG approach to PSA validation and application.

Author (EI)

Assessments; Risk; Accident Prevention; Probability Theory

19980004440

Results of applying the BWROG PSA Peer Review Certification guidelines

Krueger, Gregory A., PECO Energy Co., USA; Burns, Edward T.; Hill, Richard A.; American Society of Mechanical Engineers, Pressure Vessels and Piping Division (Publication) PVP. Risk-Informed Decision Making; 1997; ISSN 0277-027X; Volume 358, pp. 87-92; In English; 1997 ASME Pressure Vessels and Piping Conference, Jul. 27-31, 1997, Orlando, FL, USA; Copyright; Avail: Issuing Activity

Probabilistic Safety Assessment (PSA) Peer Review Certification Implementation Guidelines have been developed by the Boiling Water Reactor Owners' Group (BWROG) for use in providing additional assurance that the quality of an individual plant's PSA is commensurate with the intended applications. This process establishes a formal and uniform method of assessing the quality of PSAs. It provides a useful critique to the host utility by identifying PSA technical and process areas in need of improvement. The BWROG PSA Peer Review Certification process uses 11 major PSA elements to separate considerations regarding the PSA. These 11 major elements are then subdivided into 209 PSA criteria based on subelements. These elements and subelements are contained in checklist tables that require peer review evaluation to assign 'grades' to each to each of the criteria. As part of the process development, the BWROG sponsored a pilot application of the guidelines using 3 pilot plants representing different BWR vintages and PSA methodologies. A total of 14 reviewers representing 6 different PSAs and outside observers were involved in the pilot certification process. The peer review process was identified as an effective method of identifying areas of potential enhancement of a PSA. It is oriented toward the use of the PSA for applications rather than determining the state of the art attributes of the PSA. The pilot review process revealed that the plant design and the procedures

implemented were major influences on the results and noted differences between the PSAs which led to insights to the host utilities.
Author (EI)
Assessments; Risk; Accident Prevention; Boiling Water Reactors; Probability Theory

19980011910
Risk analysis of residential fire detector performance
Grosse, Larry, Colorado State Univ., USA; DeJong, Jac; Murphy, John; Journal of Applied Fire Science; 1996-1997; ISSN 0735-6331; Volume 6, no. 2, pp. 109-126; In English; Copyright; Avail: Issuing Activity

As the percentage of American homes with smoke detectors increased to an estimated 92 percent in 1994, the fire related death rate in one- and two-family dwellings did not experience a corresponding decrease. to determine the probability of a fatality based on the performance of residential fire detectors, data from various studies were utilized and integrated into a risk analysis. to effectively accomplish this objective, a fault tree model was generated which provided the basis for the development of the risk analysis. Data generated by the National Smoke Detector Project and from real scale experiments conducted by researchers at Texas A&M University was consolidated and utilized in the development of a realistic risk analysis for the performance of fire detectors for various fire scenarios. A review of the risk analysis provides a clear example of the probability of a fatality if there is no consideration as to the risk involved with the use of the various types of fire detectors. Certain types of fire detectors are more responsive for the different types of fires. Therefore, recommendations as to the type and location of the fire detector should include the type of fire ignition that would most likely occur and the most responsive detector that can be installed in that location.
Author (EI)
Fires; Assessments; Risk; Failure Analysis; Mathematical Models; Probability Theory

19990068080
Facts and values in risk assessment
Cross, Frank B., Univ. of Texas at Austin, USA; Reliability Engineering & System Safety; Jan, 1998; ISSN 0951-8320; Volume 59, no. 1, pp. 27-40; In English; Copyright; Avail: Issuing Activity

Risk, as commonly understood, is a complex melange of facts, values, and fears. While this complexity of public risk perception is now broadly recognized, its implications are insufficiently explored. Public risk perceptions offer a poor guide for public policymaking. Popular assessments of risk are tainted by misinformation and unreliable heuristics. While subjective considerations, often called values, play a role in public perception of risk, those 'values' are often inappropriate for government decisionmaking. Reliance on public perceptions of risk means more premature deaths. Public risk perception also is systematically skewed contrary to the interests of the disadvantaged. Strict probabilistic risk measures generally provide a superior guide for government regulatory policy.
Author (EI)
Assessments; Risk; Risk; Policies; Decision Making; Probability Theory

33
ELECTRONICS AND ELECTRICAL ENGINEERING

Includes development, performance, and maintainability of electrical/electronic devices and components; related test equipment. and microelectronics and integrated circuitry. For related information see also 60 Computer Operations and Hardware; and 76 Solid-State Physics. For communications equipment and devices see 32 Communications and Radar.

19880016444 Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID, USA
Statistical evaluation of light water reactor piping damping data for use in PRA (Probabilistic Risk Assessment) analyses
Ware, A. G., Edgerton, Germeshausen and Grier, Inc., USA; Jan 1, 1988; 10p; In English
Contract(s)/Grant(s): DE-AC07-76ID-01570
Report No.(s): DE88-007708; EGG-M-29987; CONF-880661-5; Avail: CASI; A02, Hardcopy; A01, Microfiche

This paper presents the results of studies used to quantify, on a statistical basis, one of the parameters (piping system damping) input to probabilistic risk assessment (PRA) analyses of nuclear structures. Damping data were selected from tests in which the piping had been vibrated at levels representative of at least moderate severity seismic or hydrodynamic transients. These data, representing 27 light water reactor type piping systems, formed the basis for the statistical damping study. Most of these systems were actual nuclear power plant systems, and the lowest mode was less than 8 Hz in over 80/percent/ of the systems. Damping was treated as independent of frequency (or mode number). The statistical analysis showed that a lognormal probability fit

provided a suitable approximation of the raw data. For the cases in which all data were considered (which allowed duplicate tests for each system to be included so that the overall data were biased by those systems with the most data), mean lognormal damping values ranged from 2.68/percent/ to 3.55/percent/ of critical. When duplicate tests were eliminated, the means ranged from 3.12/percent/ to 3.72/percent/ of critical. For the final cases, which considered only the lowest mode at its highest excitation level, mean lognormal damping values ranged from 3.28/percent/ to 6.50/percent/ of critical.
DOE
Damping; Light Water Reactors; Pipes (Tubes); Reactor Safety; Seismic Waves; Statistical Analysis

37
MECHANICAL ENGINEERING

Includes mechanical devices and equipment; machine elements and processes. For cases where the application of a device or the host vehicle is emphasized see also the specific category where the application or vehicle is treated. For robotics see 63 Cybernetics, Artificial Intelligence, and Robotics; and 54 Man/System Technology and Life Support.

19890017825 Science Applications International Corp., McLean, VA, USA
Risk assessment of compressed natural gas-fueled vehicle operations, phase 1 ***Topical Topical Report, Dec. 1987 - Nov. 1988***
Friedman, David M., Science Applications International Corp., USA; Zuber, Laura C., Science Applications International Corp., USA; Feb 1, 1989; 192p; In English
Contract(s)/Grant(s): GRI-5087-254-1621
Report No.(s): PB89-188841; GRI-89/0037; Avail: CASI; A09, Hardcopy; A02, Microfiche

The Gas Research Institute has embarked on a technology and safety oriented program with the objective of developing a cost-effective, advanced natural gas engine, a compression station, and storage systems that will capitalize on the economic and environmental benefits of using natural gas in vehicular applications. As the first step in a two phase project, a program was initiated to develop a remotely accessible and publicly available, international data base of natural gas vehicle (NGV) safety information. Its purpose is to improve GRI's ability to conduct detailed, quantitative risk assessments of NGVs and NGV systems. In addition to bibliographic reference, scientific data are currently available in a computerized, menu-driven data base management system (DBMS). Data reflect current, domestic, and international knowledge of NGV safety, fire, and injury statistics, refueling station equipment design, and applicable codes and standards. Additional data required for a probabilistic risk assessment include topics such as vehicle component failure modes, strength of materials, natural gas physical properties, and general transportation safety statistics.
CASI
Assessments; Data Base Management Systems; Engines; Motor Vehicles; Natural Gas; Risk; Safety

38
QUALITY ASSURANCE AND RELIABILITY

Includes approaches to, and methods for reliability analysis and control, inspection, maintainability, and standardization.

19840021168 Wisconsin Univ., Mathematics Research Center., Madison, WI, USA
Stochastic models for common failures of components ***Technical Summary Report***
Harris, B., Wisconsin Univ., USA; Mar 1, 1984; 34p; In English
Contract(s)/Grant(s): DAAG29-80-C-0041
Report No.(s): AD-A141490; MRC-TSR-2659; Avail: CASI; A03, Hardcopy; A01, Microfiche

Much of the literature dealing with system failures assumes that individual subsystems or components are stochastically independent. In this report, some models that have been used for analyzing dependent failures are examined and one new time dependent stress-strength(loading) model is proposed. These models are of particular interest in the probabilistic risk assessment of nuclear reactors.
DTIC
Component Reliability; Stochastic Processes; System Failures

19860018978 Battelle Columbus Labs., OH, USA

Evaluations and utilizations of risk importances

Vesely, W. E., Battelle Columbus Labs., USA; Davis, T. C., Battelle Columbus Labs., USA; Aug 1, 1986; 130p; In English

Contract(s)/Grant(s): NRC-FIN-D-1106

Report No.(s): TI85-902167; NUREG/CR-4377; BMI-2129; Avail: CASI; A07, Hardcopy; A02, Microfiche

Approaches for utilizing Probabilistic Risk Analyses (PRA's) to determine risk importances are discussed. Risk importances are determined for design features, plant operations, and other factors that can affect risk. PRA's can be used to identify the importances of risk contributors or proposed changes to designs or operations. The objective here is to provide guidance in evaluating and applying risk importances. The utilization of both qualiltative risk importances and quantitative risk importances is described. Qualitative risk importances are based on the logic models in the PRA, while quantitative risk importances are based on the quantitative results of the PRA. Both types of importances are among the most robust and meaningful information a PRA can provide. A wide variety of risk importance evaluations are described including evaluations of the importances of design changes, testing, maintenance, degrading environments, and aging. Specific utilizations are described in inspection and in reliability assurance programs. However, the general approaches have widespread applicability. The role of personal computers and decision support programs in applying risk importance evaluations are also described.

CASI

Design Analysis; Probability Theory; Risk

19870017768 Rome Air Development Center, Griffiss AFB, NY, USA

Introduction to reliability demonstration testing of nonelectronic components ***Topical Report, May 1982 - May 1985***

Lafollette, John P., Rome Air Development Center, USA; Feb 1, 1987; 129p; In English

Report No.(s): AD-A181112; RADC-TM-86-21; Avail: CASI; A07, Hardcopy; A02, Microfiche

This report is intended as an instructional manual in demonstration testing of nonelectronic components. Primary emphasis is on truncated tests. Starting from a basic binomial model, the trade-offs between sample size, consumer risk, rejection number and the expected probability of failure are explored. The Weibull distribution is a flexible model for representing mechanical failure modes where reliability degrades with time (a hazard rate that increases with time). The time of test termination follows from the appropriate failure model and the desired reliability. Techniques are presented for analyzing truncated failure data to determine an appropriate failure model. The problems and advantages of using current military test specifications, designed for an exponential failure model, when testing mechanical components, are discussed in detail. The Probability Ratio Sequential Test (PRST) is discussed as an alternative to the truncated test. A variety of PRSTs for different failure models is presented. The Weibull PRST and the exponential PRST are compared.

DTIC

Binomials; Failure; Manuals; Mechanical Devices; Probability Theory; Reliability; Risk; Testing Time; Weibull Density Functions

19880029210

Reliability and risk models based on independent trials

Twisdale, Lawrence A., Applied Research Associates, Inc., USA; Probabilistic Engineering Mechanics; Dec 1, 1986; ISSN 0266-8920; 1, pp. 202-207; In English; Research supported by the Electric Power Research Institute; Copyright; Avail: Issuing Activity

An analysis has been made of the mathematical relationship between two alternative models for reliability and risk estimation under the assumption of mutual independence. In cases where the reliability formulation is expressible as a compound union event, the resultant reliability expressions are analogous to the Bernoulli and Poisson trials processes. Nonparametric inequality relationships are developed that demonstrate that a Bayesian-Bernoulli model always predicts event probabilities that are less than Bernoulli probabilities, which are always less than or equal to probabilities predicted by the finer grained Poisson trials model. An analysis of the maximum relative prediction error indicates when the individual probabilities are less than 0.1, the relative error between the Bernoulli and Poisson models is always less than 5 percent. The results are demonstrated to have utility in system reliability, engineered design lifetime risk analysis, and simulation applications in which the model is based on independent trials.

AIAA

Mathematical Models; Probability Theory; Reliability Analysis; Risk; Statistical Analysis

19880055631

Statistical dependence in risk and reliability analysis

Haim, M., Rafael Armament Development Authority, Israel; Apostolakis, G., California, University, USA; Jan 1, 1987; 7p; In

English; Reliability ’87, Apr. 14-16, 1987, Birmingham; Sponsored by U. K. Atomic Energy Authority, Institute of Quality Assurance, Royal Aeronautical Society.; See also A88-42851; Avail: Issuing Activity

Statistical dependence analysis should integrate two different parts, not always well distinguished: statistical dependence among failure-events and state-of-knowledge dependence. The paper deals with these two types of dependence in risk and reliability analysis. It illustrates the difference between them and refers to models of state-of-knowledge dependence. A model that integrates these two parts is demonstrated by a realistic example.

AIAA

Multivariate Statistical Analysis; Probability Theory; Reliability Analysis; Risk

19910013737 NASA Lewis Research Center, Cleveland, OH, USA

Reliability and risk assessment of structures

Chamis, C. C., NASA Lewis Research Center, USA; National Aeronautics and Space Administration, Technology 2000, Volume 1; Mar 1, 1991, pp. p 241-248; In English; See also N91-23021 14-99; Avail: CASI; A02, Hardcopy; A04, Microfiche

Development of reliability and risk assessment of structural components and structures is a major activity at Lewis Research Center. It consists of five program elements: (1) probabilistic loads; (2) probabilistic finite element analysis; (3) probabilistic material behavior; (4) assessment of reliability and risk; and (5) probabilistic structural performance evaluation. Recent progress includes: (1) the evaluation of the various uncertainties in terms of cumulative distribution functions for various structural response variables based on known or assumed uncertainties in primitive structural variables; (2) evaluation of the failure probability; (3) reliability and risk-cost assessment; and (4) an outline of an emerging approach for eventual certification of man-rated structures by computational methods. Collectively, the results demonstrate that the structural durability/reliability of man-rated structural components and structures can be effectively evaluated by using formal probabilistic methods.

CASI

Finite Element Method; Probability Theory; Reliability Analysis; Risk; Structural Design; Structural Reliability

19940024000 Sandia National Labs., Albuquerque, NM, USA

Identification of components to optimize improvement in system reliability

Painton, L., Carnegie-Mellon Univ., USA; Campbell, J., Sandia National Labs., USA; Jan 1, 1993; 6p; In English; 2nd; Probabilistic Safety Assessment and Management Conference (PSAM), 20-24 Mar. 1994, San Diego, CA, USA

Contract(s)/Grant(s): DE-AC04-94AL-85000

Report No.(s): DE94-001601; SAND-93-2420C; CONF-940312-22; Avail: CASI; A02, Hardcopy; A01, Microfiche

The fields of reliability analysis and risk assessment have grown dramatically since the 1970’s. There are now bodies of literature and standard practices which cover quantitative aspects of system analysis such as failure rate and repair models, fault and event tree generation, minimal cut sets, classical and Bayesian analysis of reliability, component and system testing techniques, and decomposition methods. In spite of the growth in the sophistication of reliability models, however, little has been done to integrate optimization models within a reliability analysis framework. That is, often reliability models focus on characterization of system structure in terms of topology and failure/availability characteristics of components. A number of approaches have been proposed to help identify the components of a system that have the largest influence on overall system reliability. While this may help rank order the components, it does not necessarily help a system design team identify which components they should improve to optimize overall reliability (it may be cheaper and more effective to focus on improving two or three components of smaller importance than one component of larger importance). In this paper, we present an optimization model that identifies the components to be improved to maximize the increase in system MTBF, subject to a fixed budget constraint. A dual formulation of the model is to minimize cost, subject to achieving a certain level of system reliability.

DOE

Algorithms; Assessments; Failure; Probability Theory; Reliability; Reliability Analysis; Risk; Systems Analysis

19980024724

Ultrasonic inspection of turbine rotor discs for stress corrosion cracking

Baborovsky, V. M., Magnox Electric plc, UK; Gull, M. J.; Insight: Non-Destructive Testing and Condition Monitoring; September, 1997; ISSN 1354-2575; Volume 39, no. 9, pp. 607-611; In English; Copyright; Avail: Issuing Activity

Stress corrosion cracking in turbine discs and keyways has been recognised for a number of years as a problem. Magnox Electric has devised and implemented a strategy to manage the threat from SCC, based on a probabilistic risk assessment technique. An important input to the risk assessment is a knowledge of existing defects and Magnox Electric has undertaken a

major programme of work to develop ultrasonic inspection techniques and equipment for SCC detection and sizing in the relevant disc geometries.
Author (EI)
Stress Corrosion Cracking; Inspection; Ultrasonics; Nondestructive Tests; Crack Initiation; Rotating Disks

19980072856

Methods and techniques for risk prediction of Space Shuttle upgrades

Hoffman, Chad R., Pratt & Whitney, USA; Pugh, Rich, Pratt & Whitney, USA; Safie, Fayssal, NASA Marshall Space Flight Center, USA; 1998, pp. 1929-1939; In English
Report No.(s): AIAA Paper 98-1938; Copyright; Avail: AIAA Dispatch

Since the Space Shuttle (SS) accident in 1986, NASA has been trying to incorporate probabilistic risk assessment (PRA) in decisions concerning the SS and other NASA projects. One major study NASA is currently conducting is in the PRA area in establishing an overall risk model for the SS system. The model is intended to provide a tool to predict the Shuttle risk and to perform sensitivity analyses and trade studies, including evaluation of upgrades. Marshall Space Flight Center (MSFC) and its prime contractors including Pratt and Whitney (P&W) are part of the NASA team conducting the PRA study. MSFC responsibility involves modeling the External Tank (ET), the Solid Rocket Booster (SRB), the Reusable Solid Rocket Motor (RSRM), and the Space Shuttle Main Engine (SSME). A major challenge that faced the PRA team is modeling the Shuttle upgrades. This mainly includes the P&W High Pressure Fuel Turbopump (HPFTP) and the High Pressure Oxidizer Turbopump (HPOTP). This paper discusses the various methods and techniques used for predicting the risk of the P&W redesigned HPFTP and HPOTP.
Author (AIAA)
Space Shuttles; Prediction Analysis Techniques; Probability Theory; Structural Reliability

19980087742

Planning of maintenance or improvements for redundant systems

Wild, Antonin, Wild & Boyd Management Advisors, Ltd., Canada; 1997, pp. 350-354; In English; Copyright; Avail: AIAA Dispatch

A valuable source of information for decisions on maintenance or improvements for redundant systems is the evaluation of importances on the basis of fault trees and cutsets, as used for the probabilistic risk assessment. This paper provides a short review of the technique, and outlines the main problem areas for its application. If properly applied, the technique leads to a more efficient use of available resources, and to an improved dependability of systems.
Author (AIAA)
Redundant Components; Maintenance; Fault Trees

19980160711

1994 Annual Reliability and Maintainability Symposium, Tutorial Notes, Anaheim, CA, Jan. 24-27, 1994

1994; In English; Copyright; Avail: Aeroplus Dispatch

Various papers on reliability and maintainability are presented. Individual topics addressed include: subroutines for product assurance; failure mode, effects, and criticality analysis; what Markov modeling can do for you; basic reliability; management, models, and standards for reliability growth; basic maintainability; practical reliability engineering and management; current practices in reliability-based probabilistic risk assessment; overview of concurrent engineering; understanding part failure mechanisms. Also discussed are: software reliability concepts; basic fault-tree analysis; design for reliability; probabilistic models and statistical methods in reliability; concepts of the statistical design of experiments; using the Taguchi method for improved reliability; reliability modeling using practical iterative techniques; fault-tolerant computing; experimental analysis of computer system dependability.
AIAA
Conferences; Maintainability; Reliability Engineering

39
STRUCTURAL MECHANICS

Includes structural element design, analysis and testing; dynamic responses of structures; weight analysis; fatigue and other structural properties; and mechanical and thermal stresses in structure. For applications see 05 Aircraft Design, Testing and Performance and 18 Spacecraft Design, Testing and Performance.

19900009154 NASA Lewis Research Center, Cleveland, OH, USA
Probability of failure and risk assessment of propulsion structural components
Shiao, Michael C., Sverdrup Technology, Inc., Cleveland, USA; Chamis, Christos C., NASA Lewis Research Center, USA; Johns Hopkins Univ., The 1989 JANNAF Propulsion Meeting, Volume 1; May 1, 1989, pp. p 135-162; In English; See also N90-18462 11-20; Avail: CASI; A02, Hardcopy; A06, Microfiche

Due to increasing need to account for the uncertainties in material properties, loading conditions, or geometries, a methodology was developed to determine structural reliability and the assess the risk associated with it. The methodology consists of a probabilistic structural analysis by a probabilistic finite element computer code Nonlinear Evaluation of Stochastic Structures Under Stress (NESSUS) and a generic probabilistic material properties model. The methodology is versatile and is equally applicable to high and cryogenic temperature structures. Results obtained demonstrate that the whole issue of structural reliability and risk can be formally evaluated using the methodology developed which is inclusive of uncertainties in material properties, structural parameters and loading conditions. The methodology is described in some detail with illustrative examples.
CASI
Assessments; Engine Parts; Failure Analysis; Geometry; Probability Theory; Risk; Structural Analysis; Structural Design

19920054270 NASA, Washington, DC, USA
NSTS Orbiter auxiliary power unit turbine wheel cracking risk assessment
Cruse, T. A., Vanderbilt University, USA; Mcclung, R. C., NASA, USA; Torng, T. Y., Southwest Research Institute, USA; ASME, Transactions, Journal of Engineering for Gas Turbines and Power; Apr 1, 1992; ISSN 0742-4795; 114, 2, Ap, pp. 302-308; In English; Research supported by NASA and Rockwell International Co; Copyright; Avail: Issuing Activity

The present investigation of turbine-wheel cracking problems in the hydrazine-fueled APU turbine wheel of the Space Shuttle Orbiter's Main Engines has indicated the efficacy of systematic probabilistic risk assessment in flight certification and safety resolution. Nevertheless, real crack-initiation and propagation problems do not lend themselves to purely analytical studies. The high-cycle fatigue problem is noted to generally be unsuited to probabilistic modeling, due to its extremely high degree of intrinsic scatter. In the case treated, the cracks appear to trend toward crack arrest in a low cycle fatigue mode, due to a detuning of the resonance model.
AIAA
Auxiliary Power Sources; Crack Initiation; Crack Propagation; Space Shuttle Main Engine; Space Transportation System; Turbine Wheels

19930028163 NASA Lewis Research Center, Cleveland, OH, USA
Probabilistic evaluation of uncertainties and risks in aerospace components
Shah, A. R., NASA Lewis Research Center, USA; Shiao, M. C., NASA Lewis Research Center, USA; Nagpal, V. K., Sverdrup Technology, Inc., USA; Chamis, C. C., NASA Lewis Research Center, USA; In: Computational nonlinear mechanics in aerospace engineering (A93-12151 02-31); 1992, pp. 365-415.; In English; See also A93-12151; Copyright; Avail: Issuing Activity

A methodology is presented for the computational simulation of primitive variable uncertainties, and attention is given to the simulation of specific aerospace components. Specific examples treated encompass a probabilistic material behavior model, as well as static, dynamic, and fatigue/damage analyses of a turbine blade in a mistuned bladed rotor in the SSME turbopumps. An account is given of the use of the NESSES probabilistic FEM analysis CFD code.
AIAA
Probability Theory; Risk; Space Shuttle Main Engine; Structural Design; Structural Members; Systems Stability

19930050043
Probability of failure and risk assessment of structure with fatigue cracks
Shen, Minsheng; Shen, M.–H. H., Ohio State Univ., USA; In: AIAA(ASME)ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, 34th and AIAA/ASME Adaptive Structures Forum, La Jolla, CA, Apr. 19-22, 1993, Technical Papers. Pt. 3 (A93-33876 1; 1993, pp. 1670-1679.; In English; See also A93-33876
Report No.(s): AIAA PAPER 93-1500; Copyright; Avail: Issuing Activity

A methodology is proposed for the evaluation of the reliability of a cracked structure with uncertainties in external loadings, material properties and initial crack geometry. The methodology consists of determining the probabilistic crack path and calculating the cumulative probability of failure for mixed-mode (mode I and mode II) crack propagation. The performance of the methodology is demonstrated by mode I and mixed-mode fatigue crack problems.
AIAA
Crack Initiation; Failure Modes; Fatigue Tests; Probability Theory; Risk; Structural Reliability

19990093324
Risk considerations for internal pressures
Irwin, P. A., Rowan Williams Davies and Irwin Inc., Canada; Sifton, V. L.; Journal of Wind Engineering and Industrial Aerodynamics; Sep, 1998; ISSN 0167-6105; Volume 77-78, pp. 715-723; In English; 1997 8th US National Conference on Wind Engineering, Jun. 5-7, 1997, Baltimore, MD, USA; Copyright; Avail: Issuing Activity

An approach, in which the probability of there being an opening is treated as one other factor in the risk calculation, rather than as an 'all or nothing' choice between one possibility and another, is described. The approach is well suited to wind tunnel studies and uses a modification of the upcrossing method to incorporate the risk associated with there being an opening.
Author (EI)
Risk; Pressure; Buildings; Wind Tunnels; Probability Theory

44
ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; and solar, geothermal, windpower, and waterwave conversion systems; energy storage; and traditional power generators. For technologies related to nuclear energy production see 73 Nuclear Physics. For related information see also 07 Aircraft Propulsion and Power; 20 Spacecraft Propulsion and Power, and 28 Propellants and Fuels.

19820028005
Annual review of energy. Volume 6
Hollander, J. M., editor, California, University, USA; Simmons, M. K., General Electric Co., USA; Wood, D. O., MIT, USA; Jan 1, 1981; 559p; In English; Copyright; Avail: Issuing Activity

Developments in the areas of energy resources and supply technologies, energy end use and conservation, energy policy, energy-related risks and the sociopolitical aspects of energy are reviewed. Progress in solar energy technologies over the last five years is discussed, along with the implications for reactor safety of the accident at Three Mile Island, the derivation of biomass fuels from agricultural products and the application of probabilistic risk assessment to energy technologies. Attention is also given to a program for national survival during an oil crisis, energy conservation in new buildings, the development of a USA synthetic fuel industry, the role of OPEC policies in world oil availability, the social impacts of soft and hard energy systems, and the energy implications of fixed rail mass transportation systems. Additional topics include the energy consumptions of industries, the relative economics of nuclear, coal and oil-fired electricity generation, and the role of petroleum price and allocation regulations in the management of energy shortages.
AIAA
Energy Technology; Technology Assessment

45
ENVIRONMENT POLLUTION

Includes atmospheric, water, soil, noise, and thermal pollution.

19990105796
Ecological and economic risk analysis of Everglades: Phase I restoration alternatives
Englehardt, James D., Univ. of Miami, USA; Risk Analysis; Dec, 1998; ISSN 0272-4332; Volume 18, no. 6, pp. 755-771; In English; Copyright; Avail: Issuing Activity

Evaluating alternatives for restoring the Everglades involves analysis of a complex ecological and economic system for which current knowledge is limited. Uncertain benefits and impacts are analyzed probabilistically in this paper, following otherwise accepted principles of net present value (NPV) analysis. Ecological benefits and impacts were considered in monetary terms. Probabilities for selected uncertain parameters were found by maximizing entropy. The first ecological risk conceptual model for

the Everglades ecosystem was developed to show ecological interactions. 'Current Plans' for restoration involve discharge of phosphorus-enriched water from artificial wetlands to relatively pristine Everglades marshes for 3-10 years, risking conversion of the ecosystem to a eutrophic cattail marsh. For two of the three areas studied, alternative 'Bypass Plans' were shown to avoid the loss of up to 3000 acres of sawgrass marsh at a cost that is probabilistically justified by the value of the ecosystem preserved. Sensitivity of the results to projected ecological changes, eutrophic marsh valuation, natural marsh valuation, and future values as represented in the discount rate, was examined.
Author (EI)
Assessments; Risk; Ecosystems; Ecology; Probability Theory

46
GEOPHYSICS

Includes earth structure and dynamics, aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism. For related information see 47 Meteorology and Climatology; and 93 Space Radiation.

19860007331 Lawrence Livermore National Lab., Livermore, CA, USA
Simplified seismic probabilistic risk assessment: Procedures and limitations
Shieh, L. C., Lawrence Livermore National Lab., USA; Johnson, J. J., Lawrence Livermore National Lab., USA; Wells, J. E., Lawrence Livermore National Lab., USA; Chen, J. C., Lawrence Livermore National Lab., USA; Smith, P. D., Lawrence Livermore National Lab., USA; Aug 1, 1985; 195p; In English
Report No.(s): TI85-016786; UCID-20468; NUREG/CR-4331; Avail: CASI; A09, Hardcopy; A03, Microfiche

At the request of the U.S. Nuclear Regulatory Commission, the Lawrence Livermore National Laboratory developed a simplified seismic probabilistic risk assessment (PRA) methodology. The purpose of this methodology is to reduce the costs while adequately performing seismic probabilistic risk assessments of nuclear power plants. The development of the simplified seismic methodology is summarized and guidelines for applying the procedures are explained. The development effort is part of the scope of work of the Seismic Safety Margins Research Program (SSMRP). Development efforts included: the development of simplified methodology for estimating seismic response (including response correlation and random and modeling uncertainties) directly from free-field ground acceleration; the development of guidelines for event/fault trees to be used in simplified seismic PRAs; and analysis of the Zion Nuclear Power Plant, Zion, Illinois, using the simplified methodology; and the issuance of a report giving procedure and guidelines for applying the simplified methodology.
R.J.F.
Nuclear Power Plants; Probability Theory; Risk; Seismology

19980003685
Stochastic-analytical framework for safety assessment of waste repositories: 2. Application
Selroos, Jan–Olof, Royal Inst. of Technology, Sweden; Ground Water; September-October, 1997; ISSN 0017-467X; Volume 35, no. 5, pp. 775-785; In English; Copyright; Avail: Issuing Activity

An analytical framework for probabilistic safety assessment of geological repositories is applied for a high-level nuclear waste repository. The framework is based on stochastic-analytical solution techniques and offers a versatile tool for the analysis of various scenarios. Features, events, and processes for a hypothetical repository, geosphere, and biosphere are considered. Explicit solutions in terms of the expected value and variance of the mass flux or cumulative mass flux are derived for each case considered. The uncertainty pertaining to features and events results in increased time spans of elevated hazard levels with possible exceedance of given regulatory criteria. Mass transfer processes, such as sorption and matrix diffusion, may result in significant reductions of radioactivity fluxes and subsequent doses in the biosphere.
Author (EI)
Stochastic Processes; Geology; Random Processes; Probability Theory; Accident Prevention; Assessments; Risk

19980016200
Discussion of 'Damage scenarios simulation for seismic risk assessment in urban zones' by Alex H. Barbat, Fabricio Yepez Moya, and Jose A. Canas
Kappos, A. J., Imperial Coll., UK; Earthquake Spectra; August, 1997; ISSN 8755-2930; Volume 13, no. 3, pp. 549-551; In English; Copyright; Avail: Issuing Activity

The authors presented a methodology for developing damage probability matrices and vulnerability curves for masonry structures typical of those found in Barcelona, Spain. The remarks that follow aim at clarifying the limitations of these

methodology and point at some apparent inconsistencies in some of the presented results. However, an inherent weakness was found in the suggested procedure. Although it was essentially based on a statistical approach, the actual data used for calibrating the model were very limited.
EI
Earthquake Resistance; Structural Analysis; Probability Theory; Statistical Analysis; Assessments; Risk

47
METEOROLOGY AND CLIMATOLOGY

Includes weather observation forecasting and modification

19790015437 Carolina Power and Light Co., Raleigh, NC, USA
Tornado missile risk analysis: Probability modeling, simulation methodology, and case studies ***Final Report***
Twisdale, L. A., Carolina Power and Light Co., USA; Dunn, W. L., Carolina Power and Light Co., USA; Chu, J., Carolina Power and Light Co., USA; May 1, 1978; 241p; In English
Contract(s)/Grant(s): EPRI PROJ. 616
Report No.(s): EPRI-ER-768; Avail: CASI; A11, Hardcopy; A03, Microfiche

Mathematical models of the contributing events to the tornado missile hazard at nuclear power plants were developed in which the major sources of uncertainty were considered in a probabilistic framework. These models were structured into a sequential event formalism which permits the treatment of both single and multiple missile generation events. A simulation computer code utilizing these models was developed to obtain estimates of tornado missile event likelihoods. Two case studies were analyzed: a single unit plant using the current NRC set of missiles and a two unit arrangement using an expanded missile set. Preliminary results suggest that the likelihood of missile strike and that of subsequent plant damage may be acceptably small.
D.O.E.
Computerized Simulation; Mathematical Models; Missiles; Probability Theory; Risk

19990084211
Heating degree-days for arid regions
Sen, Zekai, Istanbul Technical Univ., Turkey; Kadioglu, Mikdat; Energy (Oxford); Dec, 1998; ISSN 0360-5442; Volume 23, no. 12, pp. 1089-1094; In English; Copyright; Avail: Issuing Activity

Arid regions generally have great temperature differences between day and night. Heating degree-days are indicative of the need to heat buildings. We show that the maximum and minimum temperatures are linearly related at high significance levels. Degree-day calculations using only maximum temperature records are presented and risk assessments are explained. Regional variations of monthly degree-days are mapped and their relations to local topography examined.
Author (EI)
Arid Lands; Arid Lands; Temperature Distribution; Computation; Assessments; Risk; Probability Theory

51
LIFE SCIENCES (GENERAL)

Includes general research topics related to plant and animal biology (non–human); ecology; microbiology; and also the origin, development, structure, and maintenance, of animals and plants in space and related environmental conditions. For specific topics in life sciences see categories 52 through 55.

19690064027
Effect of uncertainty on risk taking in individual and group decisions.
Marquis, D. G.; Reitz, H. J.; Jul 1, 1969, pp. IBOROSTROENIE (; In English; See also VIORAL SCIENCE, V; Copyright; Avail: Issuing Activity

Risk taking under uncertainty in individual and group decisions, analyzing gambling and group discussion situations
AIAA
Decision Theory; Game Theory; Group Dynamics; Probability Theory; Risk

19700029843 Du Pont de Nemours (E. I.) and Co., Aiken, SC, USA

Quantitative safety analysis

Arnett, L. M., Du Pont de Nemours (E. I.) and Co., USA; Croach, J. W., Du Pont de Nemours (E. I.) and Co., USA; Apr 1, 1970; 52p; In English

Contract(s)/Grant(s): AT/07-2/-1

Report No.(s): DP-1207; Avail: CASI; A04, Hardcopy; A01, Microfiche

Probabalistic Analysis of Risk /PAR/ computer program for safety analysis

CASI

Computer Programs; Probability Theory; Risk; Safety

19940042253 Lockheed Aeronautical Systems Co., Marietta, GA, USA

Risk analysis of the C-141 WS405 inner-to-outer wing joint

Alford, R. E., Lockheed Aeronautical Systems Co., USA; Bell, R. P., Lockheed Aeronautical Systems Co., USA; Cochran, J. B., Lockheed Aeronautical Systems Co., USA; Hammond, D. O., Lockheed Aeronautical Systems Co., USA; AGARD, An Assessment of Fatigue Damage and Crack Growth Prediction Techniques 10 p (SEE N94-34581; Mar 1, 1994; 10p; In English; See also 10-39); Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

It is evident that weapon system management benefits greatly from the use of probabilistic risk assessment methods. The C-141 WS 405 inner-to-outer wing joint provides an actual case of how this technology was implemented by Lockheed and USAF engineers to determine conditions of inspection and repair for the C-141 fleet.

Author

Aircraft Maintenance; C-141 Aircraft; Cracks; Joints (Junctions); Metal Fatigue; Risk; Weapon System Management; Wings

19960020744 Dayton Univ. Research Inst., OH USA

Risk analysis in the presence of corrosion damage

Berens, A. P., Dayton Univ. Research Inst., USA; Burns, J. G., Wright Lab., USA; Dec. 1995; 10p; In English; See also 19960020736; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

To quantify the potential damaging effects of corrosion in an aging fleet of aircraft, a structural risk analysis computer code was used to calculate the probabilities of fracture under statically defined corrosion scenarios. The analysis was performed using results from a damage tolerance evaluation of a critical location on an observation class, ground support aircraft. A realistic equivalent initial flaw size distribution was assumed for the start of the analysis. Corrosion condition, defined in terms of five and ten percent thickness loss, were imposed for two subsequent periods in the life of the aircraft. The effects of detecting and repairing or not detecting the corrosion were modeled. For the scenarios and conditions assumed in this analytical sensitivity study, undetected corrosion effects led to order of magnitude increases in risk. These results indicate that corrosion damage could well impact safety in the aging aircraft fleets.

Author

Risk; Aircraft Safety; Aircraft Maintenance; Stress Corrosion Cracking; Structural Analysis; Damage Assessment; Probability Theory; Applications Programs (Computers)

19960020745 Aeronautical Systems Div., Wright-Patterson AFB, OH USA

Risk assessment of an aging military trainer aircraft

Lincoln, John W., Aeronautical Systems Div., USA; Widespread Fatigue Damage in Military Aircraft; Dec. 1995; 12p; In English; See also 19960020736; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

The paper examines the adequacy of the U.S. Air Force damage tolerance inspection criterion for protecting the safety of the flight of an aging military trainer aircraft. This is done through a risk assessment on the basis of cracks found in teardown inspections of retired wings. The crack population is combined with stress probabilities representing service experience to determine single flight probability of failure and the single aircraft probability of failure at a given time. These quantities are then used as a basis for judging the required inspection interval. For the case studied, the 0.9 probability of detection inspection criterion in the Air Force damage tolerance requirements may be unconservative.

Author

Risk; Reliability Analysis; Inspection; Aircraft Maintenance; Damage Assessment; Tolerances (Mechanics); Training Aircraft; Military Operations; Structural Analysis; Probability Theory

19990039115 CSA Engineering, Inc., Palo Alto, CA USA
Risk Analysis for Modeling Damage at Multiple Sites ***Final Report, 23 Sep. 1992 - 31 Jan. 1994***
Berens, Alan P.; Gallagher, Joseph P.; Dhar, Subrato; Feb. 1994; 65p; In English
Contract(s)/Grant(s): F33615-90-C-3211
Report No.(s): AD-A361253; ASIAC-TR-94-14; UDR-TR-94-15; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

In this first phase of a two phase study to develop a computer program for risk analysis of fatigue damage at multiple sites, the computer code PROF was demonstrated to be applicable to the multi-element damage (MED) problem. The application requires the damage tolerant analysis and crack size input for each of the relevant structural elements and for the relevant combinations of intact and failed conditions of the subcritical structural elements on the critical elements. The demonstration was preformed incorporating the effects of two subcritical elements on the failure probability of the chordwise joint at WS405 of the C-141 airframe. The application of PROF in the MSD area is not as clear. Since the largest crack in a lap joint will grow the fastest, the population of crack sizes to be modelled should be defined in terms of the largest crack in the zones of equivalent stresses. The sizes of the cracks in the holes immediately adjacent to the largest crack must be accounted for but several studies have indicated that the sizes of the cracks in more remote holes are not important drivers. Reasonable scenarios can be defined to bound the fracture probabilities given complete damage tolerant analyses and crack size data.
DTIC
Computer Programs; Damage Assessment; Transport Aircraft; Risk; C-141 Aircraft; Probability Theory

19990053566 Dayton Univ. Research Inst., Research Inst., OH USA
Update of the Probability of Fracture (PROF) Computer Program for Aging Aircraft Risk Analysis, Volume 1, Modifications and User's Guide ***Final Report, Sep. 1996 - Nov. 1998***
Hovey, Peter W.; Berens, Alan P.; Loomis, John S.; Nov. 1998; 92p; In English
Contract(s)/Grant(s): F09603-95-D-0175; AF Proj. FAAF
Report No.(s): AD-A363010; UDR-TR-1998-00154-VOL-1; AFRL-VA-WP-TR-1999-3030; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The computer program, Probability of Fracture (PROF) was written to facilitate the Air Force implementation of structural risk analyses. The fracture probabilities from a PROF run directly complement the deterministic damage tolerance analyses that form the bases for structural maintenance actions. However, there are many structural scenarios that cannot be modeled directly by a single PROF run, but can be analyzed through the combination of multiple PROF runs. These include the scenarios introduced by widespread fatigue damage and corrosive thinning. While these more complex applications of PROF have been demonstrated, they were difficult to implement because of the post processing required of the individual PROF runs. Further, to accommodate the calculation of failure due to discrete source damage in the presence of widespread fatigue damage, a different failure criterion was needed. Therefore, PROF was updated to accommodate these calculations and to incorporate more robust computational algorithms. This report describes the modifications made to PROF and serves as a users guide for the program. Volume 2 is a programmers guide to the PROF software.
DTIC
Probability Theory; Risk; Structural Analysis; User Manuals (Computer Programs); Aging (Metallurgy); Cracking (Fracturing)

52
AEROSPACE MEDICINE

Includes the biological and physiological effects of atmospheric and space flight (weightlessness, space radiation, acceleration, and altitude stress) on the human being; and the prevention of adverse effects on those environments. For psychological and behavioral effects of aerospace environments see 53 Behavioral Science. For the effects of space on animals and plants see 51 Life Sciences.

19820024053 Oak Ridge National Lab., Health and Safety Research Div., TN, USA
Probabilistic methodology for estimating radiation induced cancer risk
Dunning, D. E., Jr., Oak Ridge National Lab., USA; Leggett, R. W., Oak Ridge National Lab., USA; Williams, L. R., Oak Ridge National Lab., USA; Jan 1, 1981; 7p; In English
Contract(s)/Grant(s): W-7405-ENG-26
Report No.(s): DE82-001474; CONF-810905-22; Avail: CASI; A02, Hardcopy; A01, Microfiche

A computer code was developed to provide a versatile and convenient methodology for radiation risk assessment. The code allows as input essentially any dose pattern commonly encountered in risk assessments for either acute or chronic exposures, and this includes consideration of the age structure of the exposed population. Results produced by the analysis include the probability

of one or more radiation-induced cancer deaths in a specified population, expected numbers of deaths, and expected years of life lost as a result of premature fatalities. These calculations include consideration of competing risks of death from all other causes. The program also generates a probability frequency distribution of the expected number of cancers in any specified cohort resulting from a given radiation dose. The methods may be applied to any specified population and dose scenario.
DOE
Cancer; Computer Programs; Probability Theory; Risk

19970004677 Naval Medical Research Inst., Bethesda, MD USA
Statistically Based Decompression Tables X: Real-Time Decompression Algorithm Using a Probabilistic Model*, Jan. 1991 - Dec. 1993*
Survanshi, S. S., Naval Medical Research Inst., USA; Weathersby, P. K., Naval Medical Research Inst., USA; Thalmann, E. D., Naval Medical Research Inst., USA; Mar. 1996; 44p; In English
Contract(s)/Grant(s): M0099
Report No.(s): AD-A308010; NMRI-96-06; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Underwater decompression meters or computers sense a diver's changes of depth in real-time and calculate a decompression schedule for the individual diver's exposure. Currently available devices compare calculated nitrogen tissue tensions to a set of stored 'safe' constants. No explicit quantitative connection between these rules a nd the risk of decompression sickness has been established. Well calibrated probabilistic models, even though computationally more intense, can be used to specify decompression procedures tailored to control the risk of decompression sickness. Probabilistic models allow conscious choice of the degree of 'safety' or acceptable risk. Previously, the choice required searching up to tens of thousands of possibilities for any given dive. That method cannot be employed in real time without a very fast computer. We describe a quicker search method that depends upon a 'recent optimal' solution so that it can be implemented in real time. The real time algorithm compared favorably with decompression schedules obtained by extensive searches. Timing requirements for updating calculations (important for hardware specification) depends on how fast the 'recent optimal' answer changes. Risk management for repetitive diving is described in terms of conditional probability. The algorithm can be used to permit the acceptable risk level to vary during real time as the dive severity increases, and to include multiple breathing gases.
DTIC
Diving (Underwater); Breathing Apparatus; Probability Theory; Pressure Reduction; Real Time Operation; Risk; Decompression Sickness

54
MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human factors engineering; bionics, man-machine, life support, space suits and protective clothing. For related information see also 16 Space Transportation and 52 Aerospace Medicine..

19820007913 Sandia National Labs., Albuquerque, NM, USA
Simulator data on human error probabilities
Kozinsky, E. J., General Physics Corp., USA; Guttmann, H. E., Sandia National Labs.; Jan 1, 1981; 7p; In English; ANS/ENS Topical Meeting on Probabilistic Risk Assessment, 20 Sep. 1981, Port Chester, NY, USA
Contract(s)/Grant(s): DE-AC04-76DP-00789
Report No.(s): DE81-026094; SAND-81-1707C; CONF-810905-4; Avail: CASI; A02, Hardcopy; A01, Microfiche
Analysis of operator errors on NPP simulators was used to determine human error probabilities (HEP). Simulator data tapes are analyzed for operator error rates. The tapes collected, using performance measurement system software, contain a history of all operator manipulations during simulated casualties. Analysis yields a time history or operational sequence diagram and a manipulation summary, both stored in computer data files. Data searches yield information on operator errors of omission and commission. This work experimentally determined HEP's for probabilistic risk assessment calculations.
DOE
Error Analysis; Human Factors Engineering; Man Machine Systems; Task Complexity

19840003696 Sandia National Labs., Albuquerque, NM, USA
An approach to modeling of human performance for purposes of probabilistic risk assessment
Swain, A. D., Sandia National Labs., USA; Jan 1, 1983; 29p; In English; NATO Human Factors Meeting on the Theory and Nature of Human Error, 5-10 Sep. 1983, Bellagio, Italy

Contract(s)/Grant(s): DE-AC04-76DP-00789
Report No.(s): DE83-009292; SAND-83-0447C; CONF-830902-1; Avail: CASI; A03, Hardcopy; A01, Microfiche

The general approach taken in NUREG/CR-1278 to model human performance in sufficient detail to permit probabilistic risk assessments of nuclear power plant operations is described. to show the basis for the more specific models in the above NUREG, a simplified model of the human component in man-machine systems is presented, the role of performance shaping factors is discussed, and special problems in modeling the cognitive aspect of behavior are described.

DOE

Human Performance; Nuclear Power Plants; Operators (Personnel); Reactor Safety; Risk

19850005167 General Physics Corp., Columbia, MD, USA

Human reliability data bank: Feasibility study

Comer, K., General Physics Corp., USA; Miller, D. P., Sandia Labs, USA; Donovan, M., General Physics Corp.; Jan 1, 1984; 9p; In English; Human Factors Soc. Ann. Meeting, 22 Oct. 1984, San Antonio, TX, USA
Contract(s)/Grant(s): DE-AC04-76DP-00789
Report No.(s): DE84-015215; SAND-84-1569C; CONF-841099-2; Avail: CASI; A02, Hardcopy; A01, Microfiche

The US Nuclear Regulatory Commission and Sandia National Laboratories have been developing a plan for a human reliability data bank since August 1981. This research is in response to the data needs of the nuclear power industry's probabilistic risk assessment community. The three phases of the program are to: (1) develop the data bank concept; (2) develop an implementation plan and conduct a feasibility study; and (3) assist a sponsor in implementing the data bank. The program is now in Phase 2. The methods used in the feasibility study are described. Decisions to be made in the future regarding full scale implementation will be based, in part, on the outcome of this study.

DOE

Data Processing; Data Retrieval; Data Storage; Human Performance; Information Systems; Reliability

19860021752 Edgerton, Germeshausen and Grier, Inc., System Safety Development Center., Idaho Falls, ID, USA

Impact of the human on system safety analysis

Nertney, R. J., Edgerton, Germeshausen and Grier, Inc., USA; Horman, R. L., Edgerton, Germeshausen and Grier, Inc., USA; Sep 1, 1985; 34p; In English
Contract(s)/Grant(s): DE-AC07-76ID-01570
Report No.(s): DE86-008182; SSDC-32; Avail: CASI; A03, Hardcopy; A01, Microfiche

The impact of the human and human reliability on the results of probabilistic risk assessment studies is discussed in terms of some of the standard models used in risk quantification. Three levels of analysis are considered: (1) identification of areas where the human affects the operational risks; (2) rough scaling and quantification of the effect of the human on operational outcome; and (3) complete quantification of the risks including consideration of human reliability.

DOE

Error Analysis; Fault Trees; Human Performance; Probability Theory; Reliability Analysis; Risk; Safety

19920024743 EG and G Energy Measurements, Inc., National Engineering Lab., Idaho Falls, ID, USA

Reviewing the impact of advanced control room technology

Wilhelmsen, C. A., EG and G Energy Measurements, Inc., USA; Gertman, D. I., EG and G Energy Measurements, Inc., USA; Ostrom, L. T., EG and G Energy Measurements, Inc., USA; Nelson, W. R., EG and G Energy Measurements, Inc., USA; Galyean, W. J., EG and G Energy Measurements, Inc., USA; Byers, J. C., EG and G Energy Measurements, Inc., USA; Jan 1, 1992; 4p; In English; 5th; Conference on Human Factors and Power Plants: Power Generation - The Next Decade and Beyond, 7-11 Jun. 1992, Monterey, CA, USA
Contract(s)/Grant(s): DE-AC07-76ID-01570
Report No.(s): DE92-018032; EGG-M-91550; CONF-9206106-1; Avail: CASI; A01, Hardcopy; A01, Microfiche

Progress to date on assessing the nature of the expected changes in human performance and risk associated with the introduction of digital control, instrumentation, and display systems is presented. Expected changes include the shift toward more supervisory tasks, development of intervention strategies, and reallocation of function between human and machine. Results are reported in terms of the scope of new technology, human performance issues, and crews experience with digital control systems in a variety of industries petrochemical and aerospace. Plans to conduct a limited Probabilistic Risk Assessment/Human Reliability Assessment (PRA/HRA) comparison between a conventional NUREG-1150 series plant and that same plant retrofit

with distributed control and advanced instrumentation and display are also presented. Changes needed to supplement existing HRA modeling methods and quantification techniques are discussed.
DOE
Control Equipment; Display Devices; Ground Based Control; Human Factors Engineering; Measuring Instruments; Nuclear Power Plants; Nuclear Reactor Control; Nuclear Reactors; Reactor Design; Rooms

19980023575
Methodology for Space Station Freedom crew-machine interface risk assessment
Leonard–Hood, Dana, McDonnell Douglas Aerospace, USA; Rogers, Christopher W., McDonnell Douglas Aerospace, USA; Sep. 1993; In English
Report No.(s): AIAA Paper 93-4194; Copyright; Avail: Aeroplus Dispatch

This paper presents a practical and quantitative methodology for assessing human-machine interface designs which is being implemented in the SSF Program. The methodology integrates accepted probabilistic risk assessment mathematics and Technique for Human Error Rate Prediction (THERP) methods to determine parameters for a binomial probabilistic equation. Steps in the process include analysis of potential design risks, construction of Design Reference Tasks, task analysis, definition of failure modes, criticality and consequences, calculation of design risk factors, and sensitivity analyses to assess the significance of potential design changes. This methodology provides an objective process for assessing potential improvements in the crew-machine interface design by providing a means of comparing the relative value of the various design options.
Author (revised by AIAA)
Space Station Freedom; Spacecrews; Human-Computer Interface; Risk; Failure Modes

19980160675
A quantitative, probabilistic approach to human-rating of space systems
Rutledge, Pete, NASA, USA; Buchbinder, Ben, NASA, USA; 1994, pp. 216-221; In English; Copyright; Avail: Aeroplus Dispatch

This paper presents the quantitative, probabilistic approach to human rating proposed by the authors, together with the current status of this issue at NASA. The authors suggest that decisions on human rating must be made based on the probability of crew survival. The probability of crew survival, in turn, is calculated by applying probabilistic risk modeling to the space system. Not only does this yield the desired quantification for use by the decision-maker, but it results in a dynamic tool for use throughout the system life cycle to identify and focus available risk reduction resources on the system's primary risk drivers. In conclusion, while human rating can be achieved by the application of classical engineering design techniques including redundancy, fault tolerance, and safety margins, it can be measured only in terms of the probability of crew survival. This ability to measure crew survival probability through probabilistic risk assessment (PRA) methods provides the framework for: trade studies by which to optimize crew survival among the many competing system design variables and the most resource-efficient application of the classical engineering design techniques to achieve crew survival goals.
Author (AIAA)
Launch Vehicles; Spacecrews; Survival; Probability Theory

59
MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

Includes general topics and overviews related to mathematics and computer science. For specific topics in these areas see categories 60 through 67.

19700079382 Naval Postgraduate School, Monterey, CA, USA
Derivation of additional probabilistic information for analyzing decisions under risk
Dowling, J. P., Jr., Naval Postgraduate School, USA; Jan 1, 1900; 41p; In English
Report No.(s): AD-713050; Avail: CASI; A03, Hardcopy, Unavail. Microfiche

No abstract.
Decision Theory; Management Information Systems; Probability Theory; Risk

60
COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware and data processing. For components see 33 Electronics and Electrical Engineering. For computer vision see 63 Cybernetics, Artificial Intelligence and Robotics.

19920004455 General Accounting Office, Information Management and Technology Div., Washington, DC, USA
Computer security: Unauthorized access to a NASA scientific network. Report to the Chairman, Committee on Science, Space, and Technology, House of Representatives
Bowlin, Samuel W., General Accounting Office, USA; Nov 1, 1989; 19p; In English
Report No.(s): GAO/IMTEC-90-2; B-233721; Avail: CASI; A03, Hardcopy; A01, Microfiche

SPAN is a worldwide computer network linking computers used by scientists conducting NASA space and earth science research. Authorized users from almost anywhere in the world can connect to a computer on SPAN using a home computer and the public telephone system. NASA records show that between 1981 and March 1989, unauthorized users successfully gained access dozens of times to SPAN computers and used the network to gain access to other SPAN computers located at NASA and another Federal agency. Because SPAN was designed to facilitate the exchange of scientific information, NASA has to balance the desire for convenience and openness with the need to protect valuable scientific data from unauthorized users. NASA has taken or is in the process of taking some actions in response to the security incidents, but they have not performed a security risk analysis for SPAN, and therefore do not know the extent of the network's vulnerabilities or the kinds and level of security precautions that should be taken. The General Accounting Office (GAO) recommends that the NASA Administrator should: (1) ensure that a risk analysis of SPAN is performed and documented; (2) ensure that NASA, in cooperation with the SPAN users, institutes the security measures developed as a result of the risk analysis; and (3) continue to report the computer security area as a material internal control weakness in this year's report to the President and the Congress, and discuss the actions that will be taken to correct the weakness.
J.P.S.
Communication Networks; Computer Information Security; Computer Networks; Probability Theory; Risk; Selective Dissemination of Information

61
COMPUTER PROGRAMMING AND SOFTWARE

Includes software engineering, computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM. For computer software applied to specific applications, see also the associated category.

19830006710 Texas Univ., Center for Cybernetic Studies., Austin, TX, USA
Chance constrained programming methods in probabilistic programming
Charnes, A., Texas Univ., USA; Cooper, W. W., Texas Univ., USA; Mar 1, 1982; 18p; In English
Contract(s)/Grant(s): N00014-75-C-0569; N00014-81-C-0236; N00014-81-C-0410; MDA903-81-C-0365
Report No.(s): AD-A119553; CCS-RR-427; Avail: CASI; A03, Hardcopy; A01, Microfiche

This is a response to the article 'Decision Problems Under Risk and Chance Constrained Programming: Dilemmas in the Transition' (25) in which Professors Hogan, Morris and Thompson (HMT hereafter) recommend abandonment of Chance Constrained Programming (=CCP) in favor of Stochastic Programming with Recourse (=SPR)--which we shall also refer to as 2-stage Linear Programming Under Uncertainty (=LPUU) since this is the main variant of SPR which is relied upon for these conclusions in (25). In the interest of clarity and brevity, we do not pursue all of the topics covered in (25) since, as will become evident, a rather lengthy response is required to chase down even major issues. We also believe that (25) is directed to conceptual rather than practical issues of application and so, also for brevity, we brush aside qualifiers that appear in statements like the following: 'We wish to emphasize that recourse problems characterize almost all (sic) real decision problems involving risk.' Except for possibly affording some degree of protection to HMT, we do not see that such qualifiers serve any useful purpose.
DTIC
Decision Theory; Linear Programming; Probability Theory; Risk

19830013561 Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID, USA
Use of COMCAN 3 in system design and reliability analysis
Rasmuson, D. M., Edgerton, Germeshausen and Grier, Inc., USA; Shepherd, J. C., Edgerton, Germeshausen and Grier, Inc., USA; Marshall, N. H., Edgerton, Germeshausen and Grier, Inc., USA; Fitch, L. R., Edgerton, Germeshausen and Grier, Inc., USA; Mar

1, 1982; 178p; In English
Contract(s)/Grant(s): DE-AC07-76ID-01570
Report No.(s): DE82-015386; EGG-2187; Avail: CASI; A09, Hardcopy; A02, Microfiche

The COMCAN III computer program and its use are described. The COMCAN III is a tool that can be used by the reliability analyst performing a probabilistic risk assessment or by the designer of a system desiring improved performance and efficiency. The COMCAN III can be used to determine minimal cut sets of a fault tree, to calculate system reliability characteristics, and to perform qualitative common cause failure analysis.
DOE
Computer Programs; Design Analysis; Reliability Analysis; Risk

19960041498 Sandia National Labs., Albuquerque, NM USA
Risk management: What about software?
Fletcher, Sharon K., Sandia National Labs., USA; [1996]; 13p; In English; 14th; National System Safety Conference, 12-17 Aug. 1996, Albuquerque, NM, USA
Contract(s)/Grant(s): DE-AC04-94AL-85000
Report No.(s): SAND-96-1140C; CONF-960869-5; DE96-010549; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Risks in software systems arise from many directions. There are risks that the software is faulty, that the system may be attacked, that safety hazards exist, that the system may be inoperable or untimely, that an abnormal event may cause unexpected actions, etc. Risk analysis tools should support and document risk-mitigation decisions and facilitate understanding of residual risks. These tools must be based on a sound theory of risk, which does not exist today. Probabilistic risk assessment techniques apply to physically-based systems where failure modes and event dependence are fairly well understood. But they cannot be blindly applied to software systems, which do not share these characteristics. Moreover, we need to meld many diverse aspects of risk for software systems. This presentation will explore some thought-provoking ideas about modeling, problem spaces, solution approaches, math, decision friendly output, and the role of risk analysis in the software lifecycle.
DOE
Software Engineering; Risk; Computer Program Integrity

19990090010
Event Sequence Diagram framework for dynamic Probabilistic Risk Assessment
Swaminathan, S., Univ. of Maryland, USA; Smidts, C.; Reliability Engineering & System Safety; Jan, 1999; ISSN 0951-8320; Volume 63, no. 1, pp. 73-90; In English; Copyright; Avail: Issuing Activity

Dynamic methodologies have become fairly established in academia. Their superiority over classical methods like Event Tree/Fault Tree techniques has been demonstrated. Despite this, dynamic methodologies have not enjoyed the support of the industry. One of the primary reasons for the lack of acceptance in the industry is that there is no easy way to qualitatively represent dynamic scenarios. This paper proposes to extend current Event Sequence Diagrams (ESDs) to allow modeling of dynamic situations. Under the proposed ESD representation, ESDs can be used in combination with dynamic methodology computational algorithms which will solve the underlying probabilistic dynamics equations. Once engineers are able to translate their knowledge of the system dynamics and accident evolution into simple ESDs, usage of dynamic methodologies will become more popular.
Author (EI)
Computer Programs; Evaluation; Reliability; Probability Theory; Computer Systems Performance; Man Machine Systems

63
CYBERNETICS, ARTIFICIAL INTELLIGENCE AND ROBOTICS

Includes feedback and control theory, information theory, machine learning, and expert systems. For related information see also 54 Man/System Technology and Life Support.

19990032062 Department of Energy, Washington, DC USA
Dynamic Modeling of Physical Phenomena for PRAs using Neural Networks
Benjamin, A. S., Department of Energy, USA; Brown, N. N., Department of Energy, USA; Paez, T. L., Department of Energy, USA; Apr. 30, 1998; 8p; In English; Probabilistic Safety Assessment and Management (PSAM4), USA
Report No.(s): DE98-005779; SAND-98-0916C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

In most probabilistic risk assessments, there is a set of accident scenarios that involves the physical responses of a system to environmental challenges. Examples include the effects of earthquakes and fires on the operability of a nuclear reactor safety system, the effects of fires and impacts on the safety integrity of a nuclear weapon, and the effects of human intrusions on the transport of radionuclides from an underground waste complex, and their evaluation may require the use of detailed computer codes that are very time consuming to execute. Yet, to perform meaningful probabilistic analyses, it is necessary to evaluate the responses for a large number of variations in the input parameters that describe the initial state of the system, the environments to which it is exposed, and the effects of human interaction. Because the uncertainties of the system response may be very large, it may also be necessary to perform these evaluations for various values of modeling parameters that have high uncertainties, such as material stiffnesses, surface emissivities, and ground permeabilities. The authors have been exploring the use of artificial neural networks (ANNs) as a means for estimating the physical responses of complex systems to phenomenological events such as those cited above. These networks are designed as mathematical constructs with adjustable parameters that can be trained so that the results obtained from the networks will simulate the results obtained from the detailed computer codes. The intent is for the networks to provide an adequate simulation of the detailed codes over a significant range of variables while requiring only a small fraction of the computer processing time required by the detailed codes. This enables the authors to integrate the physical response analyses into the probabilistic models in order to estimate the probabilities of various responses.
NTIS
Neural Nets; Probability Theory; Risk

64
NUMERICAL ANALYSIS

Includes iteration, differential and difference equations, and numerical approximation.

19690002439 Research Analysis Corp., McLean, VA, USA
On the maximum-likelihood estimation of failure probabilities in the presence of competing risks
Anello, C., Research Analysis Corp., USA; Feb 1, 1968; 29p; In English
Contract(s)/Grant(s): DA-44-188-ARO-1
Report No.(s): AD-666400; RAC-TP-291; Avail: CASI; A03, Hardcopy; A01, Microfiche
Statistical methods of estimating failure rates of population exposed to simultaneous hazards or risks
CASI
Failure; Hazards; Mathematical Models; Probability Theory; Risk

19690018847 Boeing Scientific Research Labs., Mathematics Research Lab., Seattle, WA, USA
Chebyshev bounds for risks and error probabilities in some classification problems
Marshall, A. W., Boeing Scientific Research Labs., USA; Olkin, I., Boeing Scientific Research Labs., USA; Jan 1, 1969; 21p; In English; ITS MATH. NOTE 588
Report No.(s): AD-684495; D1-82-0819; Avail: AVAIL- ISSUING ACTIVITY
Chebyshev bounds for risks and error probabilities in some classification problems
CASI
Chebyshev Approximation; Classifications; Error Functions; Probability Theory; Risk

19960053358
Exact and asymptotic solutions for the time-dependent problem of collective ruin II
Knessl, Charles, Univ of Illinois at Chicago, USA; Peters, Craig Steven; SIAM Journal on Applied Mathematics; October 1996; ISSN 0036-1399; 56, 5, pp. 1471-1521; In English; Copyright; Avail: Issuing Activity
We consider a model for the risk reserve Z(t) of an insurance company. It is assumed that Z(t) increases due to premium intake and also as the reserve earns interest. The reserve decreases due to claims, which are modeled as a compound Poisson process. Previously we obtained an integral representation for the probability that Z(t) remains positive through time t, which is also the probability that the company survives up to this time. We now study asymptotic properties of this probability. It is assumed that the rate at which the reserve earns interest is small (but nonzero).
Author (EI)
Assessments; Asymptotic Properties; Insurance (Contracts); Mathematical Models; Poisson Density Functions; Probability Theory; Risk; Stochastic Processes

19980033823

Cross-cultural differences in risk perception: A model-based approach

Bontempo, Robert N., Columbia Univ., USA; Bottom, William P.; Weber, Elke U.; Risk Analysis; August, 1997; ISSN 0272-4332; Volume 17, no. 4, pp. 479-488; In English; Copyright; Avail: Issuing Activity

The present study assessed cross-cultural differences in the perception of financial risks. Students at large universities in Hong Kong, Taiwan, the Netherlands, and the U.S., as well as a group of Taiwanese security analysts rated the riskiness of a set of monetary lotteries. Risk judgments differed with nationality, but not with occupation (students vs. security analysts) and were modeled by the Conjoint Expected Risk (CER) model. Consistent with cultural differences in country uncertainty avoidance, CER model parameters of respondents from the two Western countries differed from those of respondents from the two countries with Chinese cultural roots: The risk judgments of respondents from Hong Kong and Taiwan were more sensitive to the magnitude of potential losses and less mitigated by the probability of positive outcomes.

Author (EI)

Culture (Social Sciences); Assessments; Risk; Economics; Mathematical Models; Probability Theory

19990100859

Computer-aided valuation of safety management

Hauptmanns, U., Otto-von-Guericke-Universitat, Germany; Process Safety and Environmental Protection: Transactions of the Institution of Chemical Engineers, Part B; Nov, 1998; ISSN 0957-5820; Volume 76, no. 4, pp. 286-290; In English; Copyright; Avail: Issuing Activity

A procedure is presented for assessing the quality of safety management. It is based on a set of questions concerning areas of relevance which have to be answered with value statements. Since such statements are vague, they are represented by fuzzy numbers. Hence they can be combined mathematically to judge the quality of management on the whole as well as that of the different areas considered. In this way weaknesses can be identified. The procedure was applied to a hazardous installation allowing a pertinent evaluation to be made within a tolerable amount of time. It is considered to have potential for replacing some of the safety analysis and auditing procedures currently in use.

Author (EI)

Computer Techniques; Accident Prevention; Assessments; Risk; Total Quality Management; Fuzzy Sets; Probability Theory

65
STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; time series and analysis; and stochastic processes.

19760026844 Florence Univ., Ist. di Ingegneria Civile., Italy

Probabilistic methods in structural engineering: Tendencies and prospects ***metodi probabilistici nell ingegneria strutturale: tendenze e prospettive***

Augusti, G., Florence Univ., Italy; Jan 1, 1974; 55p; In Italian; CNR Ann. Meeting, 29-30 Nov. 1974, Florence

Report No.(s): UFIST/05/1974; Avail: CASI; A04, Hardcopy; A01, Microfiche

The methods of probability are applied to civil and structural engineering. The aims of probabilistic approaches are determined with a discussion on a priori, a posteriori probabilities and Bayes theorem. The notions of risk and safety in structural engineering are detailed together with operational methodologies with regard to purely probabilistic, semiprobabilistic, and Monte Carlo methods. The application to normative techniques is developed. The relation between probabilistic models and statistics is emphasized with application to structural resistance and loads.

ESA

Optimization; Probability Theory; Risk; Structural Engineering

19770012892 Pennsylvania State Univ., Coll. of Business Administration., University Park, PA, USA

A probabilistic expected utility theory of risky binary choices ***Interim Report***

Fishburn, P. C., Pennsylvania State Univ., USA; Sep 1, 1976; 28p; In English

Contract(s)/Grant(s): N00014-75-C-0857; NR PROJ. 047-112

Report No.(s): AD-A031219; TR-23; Avail: CASI; A03, Hardcopy; A01, Microfiche

Let P be a real function on pairs of gambles with quantitative outcomes, with P(p,q) interpreted as the probability that an individual will choose gamble p over q when required to make a choice between the two. Assuming that outcome x is preferred to y when x = y, an incremental expected utility advantage model is defined for P. This model is based on an underlying Von

Neumann-Morgenstern utility function on outcomes and on interdependent aspects of pairs of gambles. It can be viewed as a modified expected utility model that accounts for probabilistic choice behavior. Eight axioms for P are shown to be necessary and sufficient for the incremental expected utility advantage model.
DTIC
Decision Making; Probability Theory; Risk

19810013330 Temple Univ., Dept. of Statistics., Philadelphia, PA, USA
A general approach to limiting normality of the product-limit estimator ***Interim Report***
Quinzi, A. J., Temple Univ., USA; Smith, T. M., Temple Univ., USA; Feb 1, 1981; 16p; In English
Contract(s)/Grant(s): AF-AFOSR-3673-78; AF PROJ. 2304
Report No.(s): AD-A096412; AFOSR-81-0216TR; Avail: CASI; A03, Hardcopy; A01, Microfiche
Langberg, Proschan and Quinzi obtain strongly consistent estimators for the unobservable marginal distributions of interest in the competing risks problem. These estimators resemble those of Kaplan and Meier but are appropriate when: (a) the risks are dependent and (b) death may result from simultaneous causes. We establish asymptotic normality of these estimators. Our result thereby extends that of Breslow and Crowley from the case of a continuous survival function to an arbitrary survival distribution. This preliminary report represents work currently in progress.
DTIC
Estimating; Normality; Probability Theory; Risk

19820018014 California Univ., Operations Research Center., Berkeley, CA, USA
Assessment of subjective probability
Barlow, R. E., California Univ., USA; Dec 1, 1981; 8p; In English
Contract(s)/Grant(s): AF-AFOSR-0122-81; AF PROJ. 2304
Report No.(s): AD-A111691; ORC-81-23; Avail: CASI; A02, Hardcopy; A01, Microfiche
The assessment of subjective probability is of great interest in risk analysis. Some aids for assessing subjective probability are surveyed. The connection with statistical inference and recent papers on statistical foundations are discussed.
DTIC
Probability Theory; Risk

19830004693 Battelle Memorial Inst., Office of Nuclear Waste Isolation., Columbus, OH, USA
Uncertainty analysis
Thomas, R. E., Battelle Memorial Inst., USA; Mar 1, 1982; 67p; In English
Contract(s)/Grant(s): DE-AC06-76RL-01830
Report No.(s): DE82-020058; ONWI-380; Avail: CASI; A04, Hardcopy; A01, Microfiche
An evaluation is made of the suitability of analytical and statistical sampling methods for making uncertainty analyses. The adjoint method is found to be well-suited for obtaining sensitivity coefficients for computer programs involving large numbers of equations and input parameters. For this purpose the Latin Hypercube Sampling method is found to be inferior to conventional experimental designs. The Latin hypercube method can be used to estimate output probability density functions, but requires supplementary rank transformations followed by stepwise regression to obtain uncertainty information on individual input parameters. A simple cork and bottle problem is used to illustrate the efficiency of the adjoint method relative to certain statistical sampling methods. For linear models of the form Ax=b it is shown that a complete adjoint sensitivity analysis can be made without formulating and solving the adjoint problem. This can be done either by using a special type of statistical sampling or by reformulating the primal problem and using suitable linear programing software.
DOE
Confidence Limits; Probability Theory; Risk; Sampling

19830016004 Sandia National Labs., Albuquerque, NM, USA
Some aspects of statistical modeling of human-error probability
Prairie, R. R., Sandia National Labs., USA; Jan 1, 1982; 12p; In English; DOE Statistical Symp., 1 Oct. 1982, Idaho Falls, ID, USA
Contract(s)/Grant(s): DE-AC04-76DP-00789
Report No.(s): DE83-001034; SAND-82-2202C; CONF-821021-2; Avail: CASI; A03, Hardcopy; A01, Microfiche
There are several on-going efforts in the US and elsewhere with the purpose of modeling human error such that the human contribution can be incorporated into an overall risk assessment associated with one or more aspects of nuclear power. An effort

is described that uses the human reliability analysis (event tree) to quantify and model the human contribution to risk. As an example, risk analyses are prepared on several nuclear power plants as part of the Interim Reliability Assessment Program (IREP). In this process the risk analyst selects the elements of his fault tree that could be contributed to by human error. He then solicits the HF analyst to do a HRA on this element.
DOE
Errors; Human Performance; Probability Theory; Reliability Analysis; Risk

19830070170 UK Atomic Energy Authority, Safety and Reliability Directorate., Culcheth, UK
The characterisation and evaluation of uncertainty in probabilistic risk analysis
Parry, G. W., UK Atomic Energy Authority, UK; Winter, P. W., UK Atomic Energy Authority, UK; Oct 1, 1980; 35p; In English
Report No.(s): SRD-R-190; Avail: CASI; A03, Hardcopy; Avail: CASI HC A03/; A01, Microfiche; US Sales Only
No abstract.
Probability Theory; Risk

19830073444 California Univ., Dept. of Chemical, Nuclear and Thermal Engineering., Los Angeles, CA, USA
Use of expert opinion in the evaluation of probabilities of rare events
Apostolakis, G., California Univ., USA; Mosleh, A., California Univ., USA; Jun 1, 1978; 88p; In English
Contract(s)/Grant(s): DE-AT03-76SF-70252; EY-76-S-03-0034
Report No.(s): DE82-008521; UCLA-ENG-7834; Avail: CASI; A05, Hardcopy, Microfiche
No abstract.
Nuclear Power Plants; Probability Theory; Risk

19850008263 Chicago Univ., Center for Decision Research., Chicago, IL, USA
Ambiguity and uncertainty in probabilistic inference
Einhorn, H. J., Chicago Univ., USA; Hogarth, R. M., Chicago Univ., USA; Jun 1, 1984; 84p; In English
Contract(s)/Grant(s): N00014-84-C-0018
Report No.(s): AD-A147378; TR-10; Avail: CASI; A05, Hardcopy; A01, Microfiche
Ambiguity results from having limited knowledge of the process that generates outcomes. It is argued that many real-world processes are perceived to be ambigious; moreover, as Ellsberg demonstrated, this poses problems for theories of probability operationalized via choices amongst gambles. A descriptive model of how people make judgments under ambiguity is proposed. The model assumes an anchoring-and-adjustment process in which an initial estimate provides the anchor, and adjustments are made for what might be. The latter is modeled as the result of a mental simulation process where the size of the simulation is a function of the amount of ambiguity, and differential weighting of imagined probabilities reflects one's attitude toward ambiguity. A two-parameter model of this process is shown to be consistent with: Ellsberg's original paradox, the non-additivity of complementary probabilities, current psycho-logical theories of risk, and Keynes' idea of the weight of evidence. The model is tested in four experiments involving both individual and group analyses. In experiments 1 and 2, the model is shown to predict judgments quite well; in experiment 3, the inference model is shown to predict choices between gambles; experiment 4 shows how buying and selling prices for insurance are systematically influenced by one's attitude toward ambiguity.
DTIC
Ambiguity; Decision Making; Inference; Probability Theory; Psychology; Risk

19860004518 Wisconsin Univ., Mathematics Research Center., Madison, WI, USA
Approximation of the initial reserve for known ruin probabilities ***Technical Summary Report***
Frees, E. W., Wisconsin Univ., USA; May 1, 1985; 26p; In English
Contract(s)/Grant(s): DAAG29-80-C-0041
Report No.(s): AD-A158167; MRC-TSR-2822; Avail: CASI; A03, Hardcopy; A01, Microfiche
An important problem in the study of actual risk theory is approximating the probability of ruin within finite time based on a specified initial reserve. This paper addresses the similar, but mathematically different, problem of how to approximate a desired initial reserve given a pre-specified probability of ruin. Although the procedures have desirable asymptotic properties such as consistency and asymptotic normality, these are computer-intensive and would not have been practicable before the wide spread availability of high-speed computers. The procedures rely on simulated realizations of a general risk process. Thus, these can be used in many of the mathematical models of risk processes that appear in the literature such as the Compound Poisson, ARMA

and Stochastic Discounting models. Examples of several models are given to demonstrate the versatility of the procedure and to demonstrate that the procedures are computationally feasible.
CASI
Approximation; Computerized Simulation; Failure; Mathematical Models; Probability Theory; Risk

19860011789 Lawrence Livermore National Lab., Livermore, CA, USA
Application of PRA to HEMP vulnerability analysis
Mensing, R. W., Lawrence Livermore National Lab., USA; Sep 1, 1985; 57p; In English
Contract(s)/Grant(s): W-7405-ENG-48
Report No.(s): DE86-001781; UCID-20553; Avail: CASI; A04, Hardcopy; A01, Microfiche

Vulnerability analyses of large systems, e.g., control and communication centers, aircraft, ships, are subject to many uncertainties. A basic source of uncertainty is the random variation inherent in the physical world. Thus, vulnerability is appropriately described by an estimate of the probability of survival (or failure). The estimate of the probability of survival is not a single value but a range of values. Probabilistic risk analysis (PRA) is a methodology which deals with these uncertainty issues. This report discusses the application of PRA to HEMP vulnerability analyses. Vulnerability analysis and PRA are briefly outlined and the need to distinguish between random variation and modeling uncertainty is discussed. Then a sequence of steps appropriate for applying PRA to vulnerability problems is outlined. Finally, methods for handling modeling uncertainty are identified and discussed.
DOE
Mathematical Models; Parameter Identification; Probability Theory; Risk; Vulnerability

19860016616 Sandia National Labs., Albuquerque, NM, USA
Probabilistic risk assessment course documentation. Volume 7: Environmental transport and consequence analysis
Ritchie, L. T., Sandia National Labs., USA; Alpert, D. J., Sandia National Labs., USA; Burke, R. P., Sandia National Labs., USA; Ostmeyer, R. M., Sandia National Labs., USA; Kaiser, G. D., Sandia National Labs., USA; Runkle, G. E., Raytheon Service Co., USA; Woodard, K., Pickard, Lowe and Garrick, Inc., USA; Aug 1, 1985; 399p; In English; 7volumes
Contract(s)/Grant(s): NRC FIN-A-1321
Report No.(s): TI86-002575; NUREG/CR-4350/7; SAND85-1495/7; Avail: CASI; A17, Hardcopy; A04, Microfiche

Consequence models were designed to assess health and economice risks from potential accidents at nuclear power plants. These models were applied to an ever increasing variety of problems with ever increasing demands to improve modeling capabilities and provide greater realism. The environmental transport of postulated radiological releases and the elements and purpose of accident consequence evaluation were examined. Topics addressed include: overview of health and economic consequence analysis; atmospheric transport and deposition modeling; exposure pathways; radiation dosimetry; estimating potential health effects; emergency response; economic consequences of reactor accidents; consequence modeling codes; and consequence modeling differences and issues.
Author
Accidents; Economic Impact; Emergencies; Environment Effects; Mathematical Models; Nuclear Power Plants; Pollution Transport; Reactor Safety

19880015867 Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID, USA
A perspective of PC-based probabilistic risk assessment
Sattison, M. B., Edgerton, Germeshausen and Grier, Inc., USA; Rasmuson, D. M., Edgerton, Germeshausen and Grier, Inc., USA; Robinson, R. C., Edgerton, Germeshausen and Grier, Inc., USA; Russell, K. D., Edgerton, Germeshausen and Grier, Inc., USA; Vansiclen, V. S., Edgerton, Germeshausen and Grier, Inc., USA; Jan 1, 1987; 9p; In English; Prepared in cooperation with Nuclear Regulatory Commission, Washington, D.C.
Contract(s)/Grant(s): DE-AC07-76ID-01570
Report No.(s): DE88-006715; EGG-M-33687; CONF-871234-14; Avail: CASI; A02, Hardcopy; A01, Microfiche

Probabilistic risk assessment (PRA) information has been under-utilized in the past due to the large effort required to input the PRA data and the large expense of the computers needed to run PRA codes. The microcomputer-based Integrated Reliability and Risk Analysis System (IRRAS) and the System Analysis and Risk Assessment (SARA) System, under development at the Idaho National Engineering Laboratory, have greatly enhanced the ability of managers to use PRA techniques in their decision-making. IRRAS is a tool that allows an analyst to create, modify, update, and reanalyze a plant PRA to keep the risk assessment current with the plant's configuration and operation. The SARA system is used to perform sensitivity studies on the results of a PRA. This type of analysis can be used to evaluate proposed changes to a plant or its operation. The success of these

two software projects demonstrate that risk information can be made readily available to those that need it. This is the first step in the development of a true risk management capability.
DOE
Computer Programs; Decision Making; Engineering Management; Maintenance; Probability Theory; Risk

19880021007 Chicago Univ., Center for Decision Research., Chicago, IL, USA
Venture theory: A model of decision weights
Hogarth, Robin M., Chicago Univ., USA; Einhorn, Hillel J., Chicago Univ., USA; Jan 1, 1988; 49p; In English
Contract(s)/Grant(s): N00014-84-C-0018
Report No.(s): AD-A194809; TR-21; Avail: CASI; A03, Hardcopy; A01, Microfiche
Several theories suggest that people replace probabilities by decision weights when evaluating risky outcomes. This paper proposes a model, called venture theory, of how people assess decision weights. It is assumed that people first anchor on a stated probability and then adjust this by mentally simulating other possible values. The amount of mental simulation is affected both by the extent to which the anchor deviates from the extremes of 0 and 1 (i.e., where there is no uncertainty) and the level of perceived ambiguity concerning the relevant probability. The net effect of the adjustment (i.e., up or down relative to the anchor) reflects the relative weight given in imagination to values above as opposed to below the anchor. This, in turn, is taken to be a function of both individual and situational variables, and in particular, the sign and size of payoffs. Cognitive and motivational factors therefore both play important roles in determining decision weights. Assuming that people evaluate outcomes by a prospect theory value function (Kahneman and Tversky, 1979) and are cautious in the face of risk, predictions are derived concerning attitudes toward risk and ambiguity as functions of different levels of payoffs and probabilities. The results of two experiments are reported.
DTIC
Decision Making; Mental Performance; Probability Theory; Risk

19890010478 Ohio State Univ., Dept. of Psychology., Columbus, OH, USA
A method for modeling bias in a person's estimates of likelihoods of events
Nygren, Thomas E., Ohio State Univ., USA; Morera, Osvaldo, Ohio State Univ., USA; NASA. Lyndon B. Johnson Space Center, 2nd Annual Workshop on Space Operations Automation and Robotics (SOAR 1988); Nov 1, 1988, pp. p 237-243; In English
Contract(s)/Grant(s): F33615-85-D-0514; Avail: CASI; A02, Hardcopy; A04, Microfiche
It is of practical importance in decision situations involving risk to train individuals to transform uncertainties into subjective probability estimates that are both accurate and unbiased. We have found that in decision situations involving risk, people often introduce subjective bias in their estimation of the likelihoods of events depending on whether the possible outcomes are perceived as being good or bad. Until now, however, the successful measurement of individual differences in the magnitude of such biases has not been attempted. In this paper we illustrate a modification of a procedure originally outlined by Davidson, Suppes, and Siegel (3) to allow for a quantitatively-based methodology for simultaneously estimating an individual's subjective utility and subjective probability functions. The procedure is now an interactive computer-based algorithm, DSS, that allows for the measurement of biases in probability estimation by obtaining independent measures of two subjective probability functions (S+ and S-) for winning (i.e., good outcomes) and for losing (i.e., bad outcomes) respectively for each individual, and for different experimental conditions within individuals. The algorithm and some recent empirical data are described.
CASI
Algorithms; Decision Making; Judgments; Knowledge Representation; Likelihood Ratio; Mathematical Models; Mental Performance; Probability Theory; Response Bias; Risk

19890013890 Sandia National Labs., Albuquerque, NM, USA
Techniques for applying sets code procedures to large fault trees in PRA (Probabilistic Risk Assessment) analysis
Daniel, Sharon L., Sandia National Labs., USA; Payne, Arthur C., Jr., Sandia National Labs., USA; Jan 1, 1988; 6p; In English; International Topical Meeting on Probability, Reliability and Safety Assessment, 2 Apr. 1989, Pittsburgh, PA, USA
Contract(s)/Grant(s): DE-AC04-76DP-00789
Report No.(s): DE89-004823; SAND-88-1463C; CONF-890405-10; Avail: CASI; A02, Hardcopy; A01, Microfiche
In this paper, we describe some of the new techniques developed in the Risk Methods Integration and Evaluation Program (RMIEP) for solving large fault trees and for performing external event analysis to the same level of detail as the internal event

analysis by manipulating the original internal event fault trees to include component location information. Approximations or simplifications of these techniques were used in the NUREG-1150 analyses for both internal and external events.
DOE
Computer Programs; Fault Trees; Probability Theory; Reactor Safety; Risk

19900020706 Technische Hochschule, Fachbereich Mathematik., Darmstadt, Germany
For the definition of two person zero sum games ***Zur Definitheit Von Zweipersonen-nullsummen-spielen***
Krzensk, Udo, Technische Hochschule, Germany; Jan 1, 1988; 76p; In German; Avail: CASI; A05, Hardcopy; A01, Microfiche
The problem of conflict situations between two players is studied in the case of the minimax strategies. The topology of Banach spaces was used as well as the properties of linear functions to mathematically describe the problem. The risk area of the player was characterized by compact function spaces.
ESA
Banach Space; Game Theory; Minimax Technique; Probability Theory; Risk

19940015076 Lawrence Livermore National Lab., Livermore, CA, USA
Uncertainty versus interindividual variability
Bogen, K. T., Lawrence Livermore National Lab., USA; Apr 1, 1993; 12p; In English; EPA Workshop, 19-21 Apr. 1993, Charlottesville, VA, USA
Contract(s)/Grant(s): W-7405-ENG-48
Report No.(s): DE93-018105; UCRL-JC-113547; CONF-9304125-2; Avail: CASI; A03, Hardcopy; A01, Microfiche
Distinct treatment of uncertainty and interindividual variability in variates used to model risk ensures that quantitative assessments of these attributes in modeled risk are maximally relevant to potential regulatory concerns. For example, such a distinction is required for quantitative characterization of uncertainty in population risk or in individual risk. Yet, most quantitative uncertainty analyses undertaken as part of environmental health risk assessments have failed to systematically maintain this distinction among modeled distributed input variates, and so have had limited relevance to reasonable concerns that regulators may have about how uncertainty and variability ought to relate to risk acceptability. The distinction is of course impossible if quantitative treatment of distributed input variates is rejected in favor of using single-point estimates due to the perceived impracticality of complex Monte Carlo analyses that might erroneously be thought of as being necessarily involved. Here, some practical methods are presented that facilitate implementation of the analytic framework for uncertainty and variability proposed by Bogen and Spear. Two types of methodology are discussed: one that facilitates the distinction between uncertainty and variability per se, and another that may be used to simplify quantitative analysis of distributed inputs representing either uncertainty or variability. A simple and a complex form for modeled increased risk are presented and then used to illustrate methods facilitating the distinction between uncertainty and variability in reference to characterization of both population and individual risk. Finally, a simple form of discrete probability calculus is proposed as an easily implemented, practical alternative to Monte-Carlo based procedures to quantitative integration of uncertainty and variability in risk assessment.
DOE
Assessments; Covariance; Monte Carlo Method; Populations; Probability Theory; Risk; Variability

19940023109 Los Alamos National Lab., NM, USA
Is probability of frequency too narrow?
Martz, Harry F., Los Alamos National Lab., USA; Jan 1, 1993; 9p; In English; 2nd; Probabilistic Safety Assessment and Management Conference, 20-24 Mar. 1994, San Diego, CA, USA
Contract(s)/Grant(s): W-7405-ENG-36
Report No.(s): DE94-000687; LA-UR-93-3461; CONF-940312-12; Avail: CASI; A02, Hardcopy; A01, Microfiche
Modern methods of statistical data analysis, such as empirical and hierarchical Bayesian methods, should find increasing use in future Probabilistic Risk Assessment (PRA) applications. In addition, there will be a more formalized use of expert judgment in future PRA's. These methods require an extension of the probabilistic framework of PRA, in particular, the popular notion of probability of frequency, to consideration of frequency of frequency, frequency of probability, and probability of probability. The genesis, interpretation, and examples of these three extended notions are discussed.
DOE
Probability Theory; Risk; Statistical Analysis

19940025649 Technical Research Centre of Finland, Electrical and Automation Engineering Lab., Espoo, Finland

Risk measures in living probabilistic safety assessment

Holmberg, Jan, Technical Research Centre of Finland, Finland; Johanson, Gunnar, Technical Research Centre of Finland, Finland; Niemelae, Ilkka, Technical Research Centre of Finland, Finland; May 1, 1993; ISSN 1235-0621; 73p; In English

Report No.(s): VTT-PUBS-146; ISBN 951-38-4384-X; Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

by Probabilistic Safety Assessment (PSA), nuclear power plants are assessed with respect to the likelihood of accidents. PSA provides a structured and logical procedure for the identification of credible accident sequences and for the assessment of their corresponding likelihood. to increase the availability of PSA for the operational safety management, the model as well as the whole PSA program should be developed to a more dynamic tool. The process, to update the PSA model to represent the current or planned configuration and to use the model to evaluate and direct the changes in the configuration, is called the 'living' PSA program. Risk measures needed in the living use of PSA are defined and used in the presentation of the results of the applications to end users who are the plant safety management, operational management maintenance planning personnel, designers and authorities. by proper risk measures, PSA can be better integrated with other safety management methods. Operational or design alternatives can be compared in a more understandable way, and a more effective support can be gained to react to gradual or sudden changes in the operational safety status of the plant.

ESA

Accidents; Nuclear Power Plants; Probability Theory; Reactor Safety; Risk; Safety Management

19960008664 Technische Univ., Delft, Netherlands

What is acceptable risk?

Vrijling, J. K., Technische Univ., Netherlands; Wessels, J. F. M., Technische Univ., Netherlands; Vanhengel, W., Technische Univ., Netherlands; Houben, R. J., Technische Univ., Netherlands; Aug 31, 1993; 67p; In English

Report No.(s): PB95-214227; Avail: CASI; A04, Hardcopy; A01, Microfiche

The acceptable failure probability of technical structures and systems is studied. The problem is approached from two points of view: the personal and the societal point of view. The different view points of acceptable risk lead to different criteria, although the basis of both is a cost/benefit analysis. Two trains of thought, that were put forward as an answer to the question 'What is acceptable risk,' are described and compared; it is concluded that they are in basic agreement.

Author (revised)

Acceptability; Accidents; Economic Factors; Failure; Probability Theory; Public Health; Reliability Engineering; Risk; Safety; Safety Factors

19960027510 Sandia National Labs., Albuquerque, NM USA

Hybrid processing of stochastic and subjective uncertainty data

Ferson, S., Applied Biomathematics, USA; Ginzburg, L., State Univ. of New York, USA; Cooper, J. Arlin, Sandia National Labs., USA; Nov. 1995; 26p; In English

Contract(s)/Grant(s): DE-AC04-94AL-85000

Report No.(s): SAND-95-2450; DE96-003603; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Uncertainty analyses typically recognize separate stochastic and subjective sources of uncertainty, but do not systematically combine the two, although a large amount of data used in analyses is partly stochastic and partly subjective. We have developed methodology for mathematically combining stochastic and subjective data uncertainty, based on new 'hybrid number' approaches. The methodology can be utilized in conjunction with various traditional techniques, such as PRA (probabilistic risk assessment) and risk analysis decision support. Hybrid numbers have been previously examined as a potential method to represent combinations of stochastic and subjective information, but mathematical processing has been impeded by the requirements inherent in the structure of the numbers, e.g., there was no known way to multiply hybrids. In this paper, we will demonstrate methods for calculating with hybrid numbers that avoid the difficulties. by formulating a hybrid number as a probability distribution that is only fuzzy known, or alternatively as a random distribution of fuzzy numbers, methods are demonstrated for the full suite of arithmetic operations, permitting complex mathematical calculations. It will be shown how information about relative subjectivity (the ratio of subjective to stochastic knowledge about a particular datum) can be incorporated. Techniques are also developed for conveying uncertainty information visually, so that the stochastic and subjective constituents of the uncertainty, as well as the ratio of knowledge about the two, are readily apparent. The techniques demonstrated have the capability to process uncertainty information for independent, uncorrelated data, and for some types of dependent and correlated data. Example applications are suggested, illustrative problems are worked, and graphical results are given.

DOE

Stochastic Processes; Probability Theory; Formulations; Statistical Distributions

19980033719

Words of risk analysis

Kaplan, Stan, Bayesian Systems Inc.; Risk Analysis; August, 1997; ISSN 0272-4332; Volume 17, no. 4, pp. 407-417; In English; Copyright; Avail: Issuing Activity

This paper is a transcript of a talk given to a plenary session at the 1996 Annual Meeting of the Society for Risk Analysis. Its purpose is to contribute toward a single, uniformly understood language for the risk analysis community.

Author (EI)

Words (Language); Assessments; Risk; Probability Theory

19980053215

Empirical study on intertemporal decision making under risk

Ahlbrecht, Martin, Universitaet Mannheim, Germany; Weber, Martin; Management Science; Jun, 1997; ISSN 0025-1909; Volume 43, no. 6, pp. 813-826; In English; Copyright; Avail: Issuing Activity

This study compares time preference in the cases of certainty and risk. We analyze both matching and choice behavior. We find the violations of the stationarity axiom are restricted to matching behavior, both for certainty and risk. We also compare the discounting of certain and risky outcomes as well as the discounting of gains and losses. In matching tasks, certain outcomes are discounted more than risky ones. We could not confirm these results in a choice task. Gains and losses are not found to be discounted at different rates.

Author (EI)

Decision Making; Assessments; Risk; Probability Theory; Accounting

19980060248

Application of the MTP(sub 2) property on bounds on system reliability

Gasemyr, J., Univ. of Oslo, Norway; Natvig, B.; Naval Research Logistics; Dec, 1997; ISSN 0894-069X; Volume 44, no. 8, pp. 741-755; In English; Copyright; Avail: Issuing Activity

This paper is concerned with the joint prior distribution of the dependent reliabilities of the components of a binary system. When this distribution is MTP(sub 2) (Multivariate Totally Positive of Order 2), it is shown in general that this actually makes the machinery of Natvig and Eide [7] available to arrive at the posterior distribution of the system's reliability, based on data both at the component and system level. As an illustration in a common environmental stress case, the joint prior distribution of the reliabilities is shown to have the MTP(sub 2) property. We also show, similarly to Gasemyr and Natvig [3], for the case of independent components given component reliabilities how this joint prior distribution may be based on the combination of expert opinions. A specific system is finally treated numerically.

Author (EI)

Multivariate Statistical Analysis; Reliability; Probability Theory; Failure Analysis; Numerical Analysis; Assessments; Risk

19980160716

Current practices in reliability-based probabilistic risk assessment

Friedman, Seymour L., Probabilistic Software, Inc., USA; 1994; In English; Copyright; Avail: Aeroplus Dispatch

This tutorial presents the risk assessment problems, approaches, and subsequent refinements performed on DOD, NASA, NRC, and FAA facilities, systems, and equipment. The EPA new laws and procedures are included. The presentations reflect the reliability-based Probabilistic Risk Assessment (PRA) approaches of the US National Academy of Science (NAS), the US Title III Superfund Amendments and Reauthorization Act (SARA), and the US National Response Team 'Technical Guidance for Hazards Analysis' jointly published by the EPA, DOT, and Federal Emergency Management Agency (FEMA), etc. This paper expands on the PRA methodology, derives the PRA mathematical models, and concludes with an illustrative example PRA of a small chemical processing plant.

Author (AIAA)

Risk; Reliability Engineering; Probability Theory

19980175155

Combining computational-simulations with probabilistic-risk-assessment techniques to analyze launch vehicles

Maggio, Gaspare, Science Applications International Corp., New York, USA; Fragola, Joseph R., Science Applications International Corp., New York; 1995, pp. 343-348; In English; Copyright; Avail: Aeroplus Dispatch

To assess the overall cost of a launch system the potential losses which may be incurred due to catastrophic failure should also be considered along with the manufacturing and operational costs. The potential for catastrophic failure may be determined

by performing a probabilistic risk assessment. Launch vehicles, however, operate under highly transient conditions. In addition, the complex nature of launch systems makes the task of determining the probability of failure responses and consequences, with any reasonable certainty, practically impossible. Launch vehicle dynamics may be studied by the use of computational methods, offering a solution for assessing failure responses. However, the deterministic nature of these methods makes their use incompatible with probabilistic risk assessment. This paper discusses a solution to this dilemma. A semideterministic methodology is proposed which combines these two technologies, computational simulation and probabilistic risk assessment, in a synergistic fashion. A matrix-based interfacing mechanism was developed which allows information to be transferred from one analysis structure to the other. Although software may be developed to facilitate the transfer process, the methodology may be applied without having to modify any of the existing resources. This method offers engineers the capability to integrate risk considerations directly into the design process, which has the potential of substantially reducing safety-related maintenance costs.
Author (AIAA)
Computerized Simulation; Probability Theory; Risk; Launch Vehicles; Failure Modes

19980234410

Framework for analysing decisions under risk

Danielson, Mats, Royal Inst. of Technology and Stockholm Univ., Sweden; Ekenberg, Love; European Journal of Operational Research; Feb 01, 1998; ISSN 0377-2217; Volume 104, no. 3, pp. 474-484; In English; Copyright; Avail: Issuing Activity

The main objective is to present a framework for analysing decisions under risk. The nature of much information available to decision makers is vague and imprecise, be it information for human managers in organizations or for process agents in a distributed computer environment. Some approaches address the problem of uncertainty, but many of them concentrate more on representation and less on evaluation. The emphasis in this paper is on evaluation and even though the representation used is that of probability theory, other well-established formalisms can be used. The approach allows the decision maker to be as deliberately imprecise as he feels is natural and provides him with the means for expressing varying degrees of imprecision in the input sentences. The framework we present is intended to be tolerant and to provide means for evaluating decision situations using several decision rules beside the conventional maximisation of the expected utility.
Author (EI)
Decision Theory; Assessments; Risk; Decision Making; Probability Theory; Management; Personnel

19990066817

Bayesian parameter estimation in probabilistic risk assessment

Siu, Nathan O., US Nuclear Regulatory Commission, USA; Kelly, Dana L.; Reliability Engineering & System Safety; Oct, 1998; ISSN 0951-8320; Volume 62, no. 1-2, pp. 89-116; In English; Copyright; Avail: Issuing Activity

Bayesian statistical methods are widely used in probabilistic risk assessment (PRA) because of their ability to provide useful estimates of model parameters when data are sparse and because the subjective probability framework, from which these methods are derived, is a natural framework to address the decision problems motivating PRA. This paper presents a tutorial on Bayesian parameter estimation especially relevant to PRA. It summarizes the philosophy behind these methods, approaches for constructing likelihood functions and prior distributions, some simple but realistic examples, and a variety of cautions and lessons regarding practical applications. References are also provided for more in-depth coverage of various topics.
Author (EI)
Bayes Theorem; Assessments; Risk; Parameter Identification; Probability Theory; Statistical Analysis; Mathematical Models

19990067880

Response to 'supplemental viewpoints on the use of importance measures in risk-informed regulatory applications'

Cheok, M. C., US Nuclear Regulatory Commission, USA; Parry, G. W.; Sherry, R. R.; Reliability Engineering & System Safety; Jun, 1998; ISSN 0951-8320; Volume 60, no. 3, pp. 261; In English; Copyright; Avail: Issuing Activity

In the preceding note, W.E. Vesely has provided commentary and supplementary viewpoints on the article entitled 'Use of importance measures in risk-informed regulatory applications'. This article presents some comments on some of the comments Vesely made. It focuses on the risk significance of SSCs (structures, systems, and components), and on the evaluation of FV or RAW values.
EI
Assessments; Risk; Probability Theory; Algorithms; Mathematical Models

19990067881

Supplemental viewpoints on the use of importance measures in risk-informed regulatory applications

Vesely, W. E., Science Applications Int. Corp., USA; Reliability Engineering & System Safety; Jun, 1998; ISSN 0951-8320; Volume 60, no. 3, pp. 257-259; In English; Copyright; Avail: Issuing Activity

Focusing on the Cheok, Parry and Sherry (CPS) article, some supplemental viewpoints are given on the use of risk importance measures. Emphasis is on the risk significance of SSCs (systems, structures and components). In particular, it is shown how relationships between the risk importances associated with SSCs and the risk changes which results from changing the failure probabilities or unavailabilities of the SSCs could be determined.

EI

Boolean Algebra; Assessments; Risk; Probability Theory; Failure Analysis; Boolean Functions

19990067898

Operator support system for research reactor operations and fault diagnosis through a connectionist framework and PSA based knowledge based systems

Varde, P. V., Bhabha Atomic Research Cent., India; Sankar, S.; Verma, A. K.; Reliability Engineering & System Safety; Apr, 1998; ISSN 0951-8320; Volume 60, no. 1, pp. 53-69; In English; Copyright; Avail: Issuing Activity

During reactor upset/abnormal conditions, emphasis is placed on the plant operator's ability to quickly identify the problem and perform diagnosis and initiate recovery action to ensure the safety of the plant. However, the reliability of human action is adversely affected at the time of crisis due to time stress and psychological factors. The availability of operational aids capable of monitoring the status of the plant and quickly identifying the deviation from normal operation is expected to significantly improve the operator reliability. The development of operator support systems using probabilistic safety assessment (PSA) techniques and information is finding wide application in nuclear plant operation. Often it is observed that most of the applications use a rule-based approach for diagnosis as well as safety status/transient conditions monitoring. A more efficient approach using artificial neural networks for safety status/transient condition monitoring and rule-based systems for diagnosis and emergency procedure generation has been applied for the development of a prototype operator adviser (OPAD) system for a 100 MW(th) heavy water moderated, cooled and natural uranium fueled research reactor. The development objective of this system is to improve the reliability of operator action and hence the reactor safety at the time of crisis as well as in normal operation. In order to address safety objectives at various stages of development of OPAD, the PSA techniques and tools have been used for knowledge representation. It has been demonstrated, with recall tests on the artificial neural network, that it can efficiently identify the reactor status in real-time scenario. This paper discusses various issues related to the development of an operator support system in a comprehensive way, right from the study of safety objectives, to data collection, to implementation of such a system.

Author (EI)

Reliability; Assessments; Risk; Accident Prevention; Probability Theory

19990068064

On comparing PRA results with operating experience

Martz, Harry F., Los Alamos Natl. Lab., USA; Picard, Richard R.; Reliability Engineering & System Safety; Feb, 1998; ISSN 0951-8320; Volume 59, no. 2, pp. 187-199; In English; Copyright; Avail: Issuing Activity

A procedure is presented for quantifying the consistency between probabilistic risk assessment (PRA) results and corresponding plant-specific operating data not considered in the PRA. The method, which is easily implemented in practice, is based on the use of Bayes p-values for the predictive probability that the observed data would have been produced from the PRA results in conjunction with an assumed binomial or Poisson sampling distribution. Uncertainties in both the PRA results and the operating data are considered. The method is used to quantify the consistency between PRA results and operating data for high-pressure coolant injection system unreliabilities at 11 US commercial boiling water reactors.

Author (EI)

Bayes Theorem; Assessments; Risk; Probability Theory; Sampling

19990068068

Acceptable risk as a basis for design

Vrijling, J. K., Delft Univ. of Technology, Netherlands; van Hengel, W.; Houben, R. J.; Reliability Engineering & System Safety; Jan, 1998; ISSN 0951-8320; Volume 59, no. 1, pp. 141-150; In English; Copyright; Avail: Issuing Activity

Historically, human civilisations have striven to protect themselves against natural and man-made hazards. The degree of protection is a matter of political choice. Today this choice should be expressed in terms of risk and acceptable probability of failure to form the basis of the probabilistic design of the protection. It is additionally argued that the choice for a certain technology

and the connected risk is made in a cost-benefit framework. The benefits and the costs including risk are weighed in the decision process. A set of rules for the evaluation of risk is proposed and tested in cases. The set of rules leads to technical advice in a question that has to be decided politically.
Author (EI)
Risk; Hazards; Probability Theory; Decision Making

19990068076
Risk game
Slovic, Paul, Decision Research, Inc., USA; Reliability Engineering & System Safety; Jan, 1998; ISSN 0951-8320; Volume 59, no. 1, pp. 73-77; In English; Copyright; Avail: Issuing Activity

In the context of health, safety, and environmental decisions, the concept of risk involves value judgments that reflect much more than just the probability and consequences of the occurrence of an event. This article conceptualizes the act of defining and assessing risk as a game, in which the rules must be socially negotiated within the context of a specific problem. This contextualist view of risk provides insight into why technical approaches to risk management often fail with problems such as those involving radiation and chemicals, where scientific experts and the public disagree on the nature of the risks. It also highlights the need for allowing the interested and affected parties to define and play the game, thus emphasizing the importance of institutional, procedural, and societal processes in risk-management decisions.
Author (EI)
Risk; Decision Making; Accident Prevention; Probability Theory; Assessments

19990077230
Validation of PSAs for use in risk-monitoring applications
Fleming, K. N., ERIN Engineering and Research, Inc., USA; Journal of Pressure Vessel Technology, Transactions of the ASME; Nov, 1998; ISSN 0094-9930; Volume 120, no. 4, pp. 379-383; In English; Copyright; Avail: Issuing Activity

The purpose of this paper is to examine the use of probabilistic safety assessment (PSA) tools for evaluating the risk significance of changing plant configurations. The focus of this examination is the ability of current PSA technology to evaluate time-dependent variations in risk quantities. Recent results from the South Texas Project (STP) PSA are used to quantify the magnitude of changes in initiating event frequencies. Issues associated with interpreting the results of risk monitors are discussed.
Author (EI)
Assessments; Risk; Probability Theory; Accident Prevention; Accidents; Nuclear Reactors

19990101746
Probability distribution of drawdowns in risky investments
Maslov, Sergei, Brookhaven Natl. Lab., USA; Zhang, Yi–Cheng; Physica A:; Jan 01, 1999; ISSN 0378-4371; Volume 262, no. 1-2, pp. 232-241; In English; Copyright; Avail: Issuing Activity

We study the risk criterion for investments based on the drawdown from the maximal value of the capital in the past. Depending on investor's risk attitude, thus his risk exposure, we find that the distribution of these drawdowns follows a general power law. In particular, if the risk exposure is Kelly-optimal, the exponent of this power law has the borderline value of 2, i.e. the average drawdown is just about to diverge.
Author (EI)
Probability Theory; Assessments; Risk; Optimization

19990108392
Assessment of human reliability based on evaluation of plant experience: requirements and implementation
Straeter, Oliver, GRS, Germany; Bubb, Heiner; Reliability Engineering & System Safety; Feb, 1999; ISSN 0951-8320; Volume 63, no. 2, pp. 199-219; In English; Copyright; Avail: Issuing Activity

A major problem in assessment of human failures in probabilistic safety assessment is the lack of empirical data needed for human reliability analysis (HRA). This problem is aggravated by the fact that different HRA methods use different parameters for the assessment and that HRA is currently enforced to provide data and methods for assessment of human reliability in new technical environment such as computerized control rooms, in accident management situations, or in low-power and shut down situations. Plant experience is one source to deal with this problem. In this paper, a method is presented that describes how plant experience about human failures and human performance may be used to support the process of analyzing and assessing human reliability. Based on considerations of requirements of HRA, a method is presented first which is able to describe and analyze human interactions that were observed within events. Implementation of the approach as a database application is outlined.

Second, the main results of the application of the method to 165 boiling water reactor events are presented. Observed influencing factors on human performance are discussed; estimates for probabilities are calculated and compared with the data tables of the THERP handbook. An outline is given for using the presented method for the analysis of cognitive errors or organizational aspects. Author (EI)
Reliability; Failure Analysis; Accident Prevention; Assessments; Risk; Probability Theory

66
SYSTEMS ANALYSIS AND OPERATIONS RESEARCH

Includes mathematical modeling of systems; network analysis; mathematical programming; decision theory; and game theory.

19840057976
An experimental method for diversified evaluation and risk assessment with conflicting objectives
Seo, F., Kyoto University, Japan; Sakawa, M., Kobe University, Japan; IEEE Transactions on Systems, Man, and Cybernetics; Apr 1, 1984; ISSN 0018-9472; SMC-14, pp. 213-223; In English; Copyright; Avail: Issuing Activity

An experimental method for treating diversity of evaluation for alternative regional policies with conflicting multiple objectives is presented in this paper. A measure to assess the risk for implementation of alternative policies to fail is also provided. The alternative regional policies are constructed under an efficiency criterion based on sensitivity analysis of multiattribute utility functions. Then an entropy problem is solved to evaluate dispersion of selection for policy attributes; the diversity of evaluation is considered under an equity criterion. The default index is constructed from the probability assessment by the entropy model for measuring quantitatively the diversity of evaluation, and is used to compare the acceptability of alternative policies to various groups in society. The method is applied to an empirical case study of a regional problem in the southern part of Osaka prefecture in Japan.
AIAA
Complex Systems; Decision Making; Optimization; Probability Theory; Regional Planning; Risk; Systems Analysis

19850060444
Potential uses of probabilistic risk assessment techniques for space station development
Bruske, S. Z.; Wright, R. E., EG&G Idaho, Inc., USA; Geaslen, W. D., EG&G Space Systems, USA; Jan 1, 1985; 9p; In English; Protecting intellectual property in space, March 20, 1985, McLean, VA; Sponsored by NASA, AIAA, and Mitre Corp.; See also A85-42592 20-17
Contract(s)/Grant(s): DE-AC07-76ID-01570; Copyright; Avail: Issuing Activity

It is pointed out that Probabilistic Risk Assessment (PRA) is a methodology used effectively in the nuclear power industry to determine the risk to the general public from the operation of nuclear power plants. Details regarding the application of PRA in the nuclear industry are illustrated with the aid of a simplified example. The various steps in the risk assessment process are discussed, taking into account the determination of the initiating events, aspects of event tree development, the fault tree, component failure data bases, and consequence determination. Questions regarding the application of the PRA methodology to space station computer security are also explored, giving attention to a hypothetical example to demonstrate the methodology. The purpose of the Initiating Event Logic Diagram (IELD) is to identify the threats to the space station computer security in a structured, logical manner. The Space Station Computer Security Function Event Tree is also developed.
AIAA
Computer Information Security; Probability Theory; Reliability Analysis; Risk; Space Stations

19890060804
The human factor in operation and maintenance of complex high-reliability systems
Ryan, Thomas G., U.S. Nuclear Regulatory Commission, USA; Jul 1, 1989; 8p; In English
Report No.(s): AIAA PAPER 89-5064; Copyright; Avail: Issuing Activity

Human factors issues in probabilistic risk assessment (PRAs) of complex high-reliability systems are addressed. These PRAs influence system operation and technical support programs such as maintainability, test, and surveillance. Using the U.S. commercial nuclear power industry as the setting, the paper addresses the manner in which PRAs currently treat human performance, the state of quantification methods and source data for analyzing human performance, and the role of human factors

specialist in the analysis. The paper concludes with a presentation of TALENT, an emerging concept for fully integrating broad-based human factors expertise into the PRA process, is presented.
AIAA
Human Factors Engineering; Human Performance; Maintenance; Reliability Analysis

19990084286
Level-crossing properties of the risk process
Stadje, Wolfgang; Mathematics of Operations Research; Aug, 1998; ISSN 0364-765X; Volume 23, no. 3, pp. 576-584; In English; Copyright; Avail: Issuing Activity

For the classical risk process R(t) that is linear increasing with slope 1 between downward jumps of i.i.d. random sizes at the points of a homogeneous Poisson process we consider the level-crossing process C(x) = (L(x), (A(sub i)(x), B(sub i)(x))(sub 1 less than or = i less than or = L(x))), where L(x) is the number of jumps from (x, infinity) to (- infinity, x] and A(sub i) (x) (B(sub i)(x)) are the distances from x to R(t) after (before) the ith jump of this kind. It is shown that rift toward infinity, C((center-dot)) is a stationary Markov process; its transition probabilities are determined. As an application we derive the expected value E(L(x)L(x + y)).
Author (EI)
Operations Research; Markov Processes; Probability Theory; Risk

73
NUCLEAR PHYSICS

Includes nuclear particles; and reactor theory. For space radiation see 93 Space Radiation. For atomic and molecular physics see 72 Atomic and Molecular Physics. For elementary particle physics see 77 Physics of Elementary Particles and Fields. For nuclear astrophysics see 90 Astrophysics.

19880014999 Texas Technological Univ., Dept. of Industrial Engineering., Lubbock, TX, USA
Relating design and environmental variables to reliability
Kolarik, William J., Texas Technological Univ., USA; Landers, Thomas L., Arkansas Univ., USA; New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems; Jan 1, 1988, pp. p 37-40; In English; See also N88-24374 17-73
Contract(s)/Grant(s): DNA001-85-C-0184; Avail: CASI; A01, Hardcopy; A06, Microfiche

The combination of space application and nuclear power source demands high reliability hardware. The possibilities of failure, either an inability to provide power or a catastrophic accident, must be minimized. Nuclear power experiences on the ground have led to highly sophisticated probabilistic risk assessment procedures, most of which require quantitative information to adequately assess such risks. In the area of hardware risk analysis, reliability information plays a key role. One of the lessons learned from the Three Mile Island experience is that thorough analyses of critical components are essential. Nuclear grade equipment shows some reliability advantages over commercial. However, no statistically significant difference has been found. A recent study pertaining to spacecraft electronics reliability, examined some 2500 malfunctions on more than 300 aircraft. The study classified the equipment failures into seven general categories. Design deficiencies and lack of environmental protection accounted for about half of all failures. Within each class, limited reliability modeling was performed using a Weibull failure model.
CASI
Environments; Nuclear Reactors; Reliability; Space Power Reactors; Spacecraft Design

19950063307
Modeling the degradation of nuclear components
Stock, D., Brookhaven Natl Lab, USA; Vesely, W.; Samanta, P.; IEEE Transactions on Nuclear Science; August 1994; ISSN 0018-9499; 41, 4, pt. 1, pp. 1405-1407; In English; 1993 Nuclear Science Symposium and Medical Imaging Conference (NSS-MIC'93). Part 1 (of 2), San Fransisco, CA, USA; Copyright; Avail: Issuing Activity

This paper describes component level reliability models that use information on degradation to predict component reliability, and which have been used to evaluate different maintenance and testing policies. The models are based on continuous time Markov

processes, and are a generalization of reliability models currently used in Probabilistic Risk Assessment. An explanation of the models, the model parameters, and an example of how these models can be used to evaluate maintenance policies are discussed.
Author (EI)
Degradation; Maintenance; Markov Processes; Mathematical Models; Probability Theory; Radiation Shielding; Reliability

19980004367

Alternative method for vessel risk analysis per Reg. Guide 1.154

Bishop, Bruce A., Westinghouse Energy Systems, USA; Meyer, Theodore A.; Carter, Robert G.; Gamble, Ronald M.; American Society of Mechanical Engineers, Pressure Vessels and Piping Division (Publication) PVP. Fatigue and Fracture (Vol 2); 1997; ISSN 0277-027X; Volume 346, pp. 225-229; In English; 1997 ASME Pressure Vessels and Piping Conference, Jul. 27-31, 1997, Orlando, FL, USA; Copyright; Avail: Issuing Activity

In 1995, EPRI initiated a program aimed at developing an alternative approach that would simplify the probabilistic fracture mechanics vessel risk analysis procedure and be economically efficient to implement. The proposed method is based on a relationship between the calculated probability of crack initiation (POI) and critical crack depth (a(sub c)). Using this relationship, acceptable PTS transient frequency was correlated with a(sub c) for a mean frequency of 5 x 10(sup - 6) per reactor year, which is specified as an acceptable frequency of significant flaw extension in RG1.154. This correlation establishes the acceptability of the PTS event.
EI
Thermal Shock; Pressure Vessels; Nuclear Reactors; Assessments; Risk; Probability Theory; Fracture Mechanics

19990066816

EBR-II probabilistic risk assessment: lessons learned regarding passive safety

Hill, D. J., Argonne Natl. Lab., USA; Ragland, W. A.; Roglans, J.; Reliability Engineering & System Safety; Oct, 1998; ISSN 0951-8320; Volume 62, no. 1-2, pp. 43-50; In English; Copyright; Avail: Issuing Activity

This article summarizes the results from the EBR-II Probabilistic Risk Assessment (PRA) and provides an analysis of the source of risk of the operation of EBR-II from both internal and external initiating events. The EBR-II PRA explicitly accounts for the role of reactivity feedbacks in reducing fuel damage. The results show that the expected core damage frequency from internal initiating events at EBR-II is very low, 1.6 x 10(sup -6) yr(sup -1), even with a wide definition of core damage (essentially that of exceeding Technical Specification limits). The annual frequency of damage, primarily caused by liquid metal fires, from externally initiated events (excluding earthquakes) is 3.6 x 10(sup -6$/ yr(sup -1) and the contribution of seismic events is 1.7 x 10(sup -5) yr(sup -1). Overall these results are considerably better than results for other research reactors and the nuclear industry in general and stem from three main sources: low likelihood of loss of coolant caused by low system pressure and top entry double vessels; low likelihood of loss of decay heat removal caused by reliance on passive means; and low likelihood of power/flow mismatch caused by both passive feedbacks and reliability of rod scram capability.
Author (EI)
Assessments; Risk; Accident Prevention; Nuclear Reactors; Industries; Nuclear Electric Power Generation; Reliability

19990093598

Improved response factor methods for seismic fragility of reactor building

Ozaki, M., Kansai Electric Power Co., Japan; Okazaki, A.; Tomomoto, K.; Iba, T.; Satoh, R.; Nanba, H.; Seya, H.; Moriyama, K.; Ugata, T.; Nuclear Engineering and Design; Oct 01, 1998; ISSN 0029-5493; Volume 185, no. 2-3, pp. 277-291; In English; Copyright; Avail: Issuing Activity

A seismic probabilistic risk assessment (PRA) method has been applied to evaluate the safety of nuclear reactor buildings during earthquakes. Improvement was made to two methods (based on linear response and based on non-linear response) of fragility analysis in seismic PRA. The conventional method, which is based on linear response, considers increases of seismic capacity implicitly, using the non-linear behavior of the structure. We described how to evaluate the capacity increase factor for the linear response method. Secondly, we proposed a method based on the non-linear response and a stratified two-point estimation method which can efficiently evaluate the variability of non-linear responses. We applied the two method to a PWR-type nuclear reactor building and ascertained that these method are useful and effective.
Author (EI)
Nuclear Reactors; Structural Analysis; Vibration Mode; Assessments; Risk; Accident Prevention

19990102358

Impact of assessing lower head integrity on boiling water reactor probabilistic risk assessments

Kukielka, Casimir A., PP&L, USA; Reliability Engineering & System Safety; Mar, 1999; ISSN 0951-8320; Volume 63, no. 3, pp. 267-273; In English; Copyright; Avail: Issuing Activity

The performance requirement for vessel integrity used in probabilistic risk assessments of boiling water reactors (BWR) is presented. The impact of the core damage progression and lower plenum quenching models on the likelihood of terminating the damage progression in-vessel was evaluated. The significant reduction in BWR containment failure probability that can occur when appropriate core damage and lower head quenching models are used are discussed.

EI

Probability Theory; Boiling Water Reactors; Accidents; Nuclear Reactors; Accident Prevention; Reactor Cores; Assessments; Risk

75
PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion. For ionospheric plasmas see 46 Geophysics. For space plasmas see 90 Astrophysics.

19990026138 Department of Energy, Office of Energy Research, Washington, DC USA

Preliminary Master Logic Diagram for ITER operation

Cadwallader, L. C., Department of Energy, USA; Taylor, N. P., Department of Energy, USA; Poucet, A. E., Department of Energy, USA; Apr. 30, 1998; 8p; In English; Probabilistic safety assessment and management (PSAM4)

Report No.(s): DE98-054119; INEEL/CON-97-01165; CONF-980907; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This paper describes the work performed to develop a Master Logic Diagram (MLD) for the operations phase of the International Thermonuclear Experimental Reactor (ITER). The MLD is a probabilistic risk assessment tool used to identify the broad set of potential initiating events that could lead to an offsite radioactive or toxic chemical release from the facility under study. The MLD described in this paper is complementary to the failure modes and effects analyses (FMEAs) that have been performed for ITER's major plant systems in the engineering evaluation of the facility design. While the FMEAs are a bottom-up or component level approach, the MLD is a top-down or facility level approach to identifying the broad spectrum of potential events. Strengths of the MLD are that it analyzes the entire plant, depicts completeness in the accident initiator process, provides an independent method for identification, and can also identify potential system interactions. MLDs have been used successfully as a hazard analysis tool. This paper describes the process used for the ITER MLD to treat the variety of radiological and toxicological source terms present in the ITER design. One subtree of the nineteen page MLD is shown to illustrate the levels of the diagram.

NTIS

Thermonuclear Reactions; Logic Design; Systems Engineering

81
ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

19770081005 Air Force Inst. of Tech., Wright-Patterson AFB, OH, USA

A methodology for subjective assessment of probability distributions

Grayson, A. S., Air Force Inst. of Tech., USA; Lanclos, H. J., Air Force Inst. of Tech., USA; Sep 1, 1976; 156p; In English

Report No.(s): AD-A032536; SLSR-13-76B; Avail: CASI; A08, Hardcopy, Microfiche

No abstract.

Operations Research; Predictions; Probability Theory; Risk

19820014208 Committee on Science and Technology (U.S. House)., Washington, DC, USA

Risk: Assessment, acceptability and management

Jan 1, 1981; 122p; In English; Rept. presented to the Subcomm. on Sci., Res. and Technol. Transmitted to the Comm. on Sci. and Technol., 97th Congr., 1st Sess.,, Nov. 1981, Washington, DC, USA; Prepared by Congressional Research Service, Library of Congress

Report No.(s): GPO-87-593; Avail: Subcomm. on Sci., Res. and Technol.

Risk assessment, particularly of risks to the public health resulting from government and industry decisions, is discussed. Cost/benefit analysis as applied to such situations as human deaths and the contracting of cancer by humans is discussed. The role of government regulations and standards is discussed.

R.J.F.

Decision Making; Estimating; Probability Theory; Risk; Safety

19910009686 Wisconsin Univ., Dept. of Industrial Engineering., Platteville, WI, USA

Information and problem report usage in system saftey engineering division

Morrissey, Stephen J., Wisconsin Univ., USA; Alabama Univ., Research Reports: 1990 NASA(ASEE Summer Faculty Fellowship Program; Oct 1, 1990, pp. 6 p; In English; See also N91-18967 10-99

Contract(s)/Grant(s): NGT-01-002-099; Avail: CASI; A02, Hardcopy; A03, Microfiche

Five basic problems or question areas are examined. They are as follows: (1) Evaluate adequacy of current problem/performance data base; (2) Evaluate methods of performing trend analysis; (3) Methods and sources of data for probabilistic risk assessment; and (4) How is risk assessment documentation upgraded and/or updated. The fifth problem was to provide recommendations for each of the above four areas.

CASI

Aerospace Safety; Safety Factors; Systems Engineering

19910025513

An overview of risk management techniques, methods and application

Shaw, Thomas E., Lockheed Sanders, Inc., USA; Sep 1, 1990; 15p; In English

Report No.(s): AIAA PAPER 90-3767; Copyright; Avail: Issuing Activity

An overview of various approaches, methods, and management processes associated with the risks of both traditional and extreme nature is presented. The risk identification and risk analysis steps of risk management are emphasized. Risk assessment methods such as probabilistic risk assessment (PRA) and qualitative rating methods are seen in perspective. The critical importance of the risk awareness of the program on the part of the team leadership and its individual members is emphasized.

AIAA

Management Methods; Risk; Systems Engineering

19910036596 Stanford Univ., CA, USA

Dynamic systems-engineering process - The application of concurrent engineering

Wiskerchen, Michael J., Stanford University, USA; Pittman, R. Bruce, DYSE Corp., USA; Engineering Management Journal; Jun 1, 1989; ISSN 1042-9247; 1, pp. 27-34; In English

Contract(s)/Grant(s): NCC10-1; Copyright; Avail: Issuing Activity

A system engineering methodology is described which enables users, particulary NASA and DOD, to accommodate changing needs; incorporate emerging technologies; identify, quantify, and manage system risks; manage evolving functional requirements; track the changing environment; and reduce system life-cycle costs. The approach is a concurrent, dynamic one which starts by constructing a performance model defining the required system functions and the interrelationships. A detailed probabilistic risk assessment of the system elements and their interrelationships is performed, and quantitative analysis of the reliability and maintainability of an engineering system allows its different technical and process failure modes to be identified and their probabilities to be computed. Decision makers can choose technical solutions that maximize an objective function and minimize the probability of failure under resource constraints.

AIAA

Concurrent Engineering; Design Analysis; Engineering Management; Life Cycle Costs; Mission Planning; Space Shuttles; Systems Engineering; Technology Transfer

19940023971 Lawrence Livermore National Lab., Livermore, CA, USA

Risk-based prioritization: A comparison of approaches

Strait, R. S., Lawrence Livermore National Lab., USA; Oct 1, 1993; 6p; In English; 2nd; Probabilistic Safety Assessment and Management Conference (PSAM), 20-24 Mar. 1994, San Diego, CA, USA

Contract(s)/Grant(s): W-7405-ENG-48

Report No.(s): DE94-003368; UCRL-JC-115244; CONF-940312-47; Avail: CASI; A02, Hardcopy; A01, Microfiche

The use of analytical techniques for risk-based prioritization, both quantitative and non-quantitative, is becoming much more wide spread and organizations are tailoring analytical techniques for risk management to their particular needs. This has led to the use of different techniques for different applications within the same organization, and correspondingly, the need for management to reconcile the process and results of different risk-based prioritization approaches. Different risk-based prioritization methods may be used to prioritize different types of activities, but eventually these prioritizations may need to be integrated to allocate organizational resources at a higher level or to develop an overall organizational budget. This paper focuses on comparing and contrasting the different risk-based approaches. The objective is to help management understand the different approaches, choose the best approach for their needs, and reconcile different approaches.
DOE
Cost Effectiveness; Management Methods; Priorities; Probability Theory; Risk

19960051895 NOVA Aerospace G.m.b.H., Vienna, Austria
Probabilistic safety analysis using ERES, the ESA RAMS expert system
Frisch, Brigitta, NOVA Aerospace G.m.b.H., Austria; Preyssl, Christian, European Space Agency. European Space Research and Technology Center, ESTEC, Netherlands; Stolle, Frank, CASA G.m.b.H., Germany; May 1996, pp. 355-358; In English; See also 19960051838; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche; ESA Publications Div., ESTEC, Postbus 299, 2200 AG Noordwijk, Netherlands; ESA Publications Div., ESTEC, Postbus 299, 2200 AG Noordwijk, Netherlands

The ESA RAMS expert system (ERES), where RAMS is an acronym for reliability, availability, maintainability and safety, is reported on. It was developed in order to support RAMS analyses and probabilistic risk assessment. The ERES system provides guidance through the analysis process as well as access to knowledge gained in previous analysis and lessons-learned data. The results of ERES serve as a basis upon which decisions may be made concerning the acceptability of risks and decisions in relation to areas where further investigations are required. Standardized documentation of the analytical procedures and results help to ensure effective communication between engineering and management teams within a company, between the various contractor levels, and between the contractors and ESA. The use of ERES will improve consistency and completeness in the analysis and will minimize the repetition of RAMS analyses.
Author (ESA)
Product Development; Aerospace Engineering; Computer Aided Design

19970026824 NASA Langley Research Center, Hampton, VA USA
Risk Management of NASA Projects
Sarper, Hueseyin, University of Southern Colorado, USA; Aug. 08, 1997; 46p; In English
Report No.(s): NASA-TM-112882; NAS 1.15:112882; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Various NASA Langley Research Center and other center projects were attempted for analysis to obtain historical data comparing pre-phase A study and the final outcome for each project. This attempt, however, was abandoned once it became clear that very little documentation was available. Next, extensive literature search was conducted on the role of risk and reliability concepts in project management. Probabilistic risk assessment (PRA) techniques are being used with increasing regularity both in and outside of NASA. The value and the usage of PRA techniques were reviewed for large projects. It was found that both civilian and military branches of the space industry have traditionally refrained from using PRA, which was developed and expanded by nuclear industry. Although much has changed with the end of the cold war and the Challenger disaster, it was found that ingrained anti-PRA culture is hard to stop. Examples of skepticism against the use of risk management and assessment techniques were found both in the literature and in conversations with some technical staff. Program and project managers need to be convinced that the applicability and use of risk management and risk assessment techniques is much broader than just in the traditional safety-related areas of application. The time has come to begin to uniformly apply these techniques. The whole idea of risk-based system can maximize the 'return on investment' that the public demands. Also, it would be very useful if all project documents of NASA Langley Research Center, pre-phase A through final report, are carefully stored in a central repository preferably in electronic format.
Author
NASA Programs; Risk; Project Management; Management Methods

19990064616 NASA Goddard Space Flight Center, Greenbelt, MD USA
Continuous Risk Management at NASA
Hammer, Theodore F., NASA Goddard Space Flight Center, USA; Rosenberg, Linda, Unisys Corp., USA; February 1999; 1p; In English; SM Management 1999, Feb. 1999, San Jose, CA, USA
Contract(s)/Grant(s): NAS5-32910; Copyright; Avail: Issuing Activity, Hardcopy; Abstract Only

NPG 7120.5A, ”NASA Program and Project Management Processes and Requirements” enacted in April, 1998, requires that ”The program or project manager shall apply risk management principles...” The Software Assurance Technology Center (SATC) at NASA GSFC has been tasked with the responsibility for developing and teaching a systems level course for risk management that provides information on how to comply with this edict. The course was developed in conjunction with the Software Engineering Institute at Carnegie Mellon University, then tailored to the NASA systems community. This presentation will briefly discuss the six functions for risk management: (1) Identify the risks in a specific format; (2) Analyze the risk probability, impact/severity, and timeframe; (3) Plan the approach; (4) Track the risk through data compilation and analysis; (5) Control and monitor the risk; (6) Communicate and document the process and decisions. This risk management structure of functions has been taught to projects at all NASA Centers and is being successfully implemented on many projects. This presentation will give project managers the information they need to understand if risk management is to be effectively implemented on their projects at a cost they can afford.
Author
Computer Systems Programs; Education; Risk; Probability Theory

19990068067
Integrating technical analysis and public values in risk-based decision making
Bohnenblust, Hans, Ernst Basler Partners Ltd., Switzerland; Slovic, Paul; Reliability Engineering & System Safety; Jan, 1998; ISSN 0951-8320; Volume 59, no. 1, pp. 151-159; In English; Copyright; Avail: Issuing Activity
Simple technical analysis cannot capture the complex scope of preferences or values of society and individuals. However, decision making needs to be sustained by formal analysis. The paper describes a policy framework which incorporates both technical analysis and aspects of public values. The framework can be used as a decision supporting tool and helps decision makers to make more informed and more transparent decisions about safety issues.
Author (EI)
Risk; Decision Making; Policies; Accident Prevention; Probability Theory

19990103096 NASA Goddard Space Flight Center, Greenbelt, MD USA
Continuous Risk Management: A NASA Program Initiative
Hammer, Theodore F., NASA Goddard Space Flight Center, USA; Rosenberg, Linda, Unisys Corp., USA; May 1999; In English; 11th, May 1999, Salt Lake, UT, USA
Contract(s)/Grant(s): NAS5-32910; Copyright; Avail: Issuing Activity; Abstract Only, Hardcopy, Microfiche
NPG 7120.5A, ”NASA Program and Project Management Processes and Requirements” enacted in April, 1998, requires that ”The program or project manager shall apply risk management principles...” The Software Assurance Technology Center (SATC) at NASA GSFC has been tasked with the responsibility for developing and teaching a systems level course for risk management that provides information on how to comply with this edict. The course was developed in conjunction with the Software Engineering Institute at Carnegie Mellon University, then tailored to the NASA systems community. This presentation will briefly discuss the six functions for risk management: (1) Identify the risks in a specific format; (2) Analyze the risk probability, impact/severity, and timeframe; (3) Plan the approach; (4) Track the risk through data compilation and analysis; (5) Control and monitor the risk; (6) Communicate and document the process and decisions.
Author
Probability Theory; Risk; Software Engineering; Project Management; Software Reliability

82
DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography. For computer documentation see 61 Computer Programming and Software.

19980175153
Databases for reliability and probabilistic risk assessment
Thaggard, Michael, USA; 1995, pp. 327-336; In English; Copyright; Avail: Aeroplus Dispatch
NASA Headquarters is developing a risk-assessment-reliability-availability-maintainability-supportabil ity (RRAMS) database architecture that includes two types of database files. The first file type incorporates historical information derived from Test Range launch performance records. The second type includes an assimilation of reliability calculations and statistical uncertainties determined after the launch performance reports were evaluated. The database files represent the compilation of a

unique consortium of space flight reliability information. Launch records, dating as far back as 1956 and including information on significant launch events that have taken place at the Cape Canaveral facility over the years, are documented in the NASA database. Details on the applications of the database are formulated after a discussion is presented on its contents and the process used in generating the initial structure. The NASA Data Encoding and Risk and Reliability databases in their current form offer valuable tools for assisting risk and reliability engineers in conducting aerospace risk and reliability studies. Some of these benefits are summarized in this paper.
AIAA
Data Bases; Reliability Engineering; Probability Theory; Risk; Failure Modes; NASA Space Programs

19990025932 Vanderbilt Univ., School of Engineering, Nashville, TN USA
Minority Engineering Summer Research Program, 1997 ***Final Report***
White, Edward J.; Bowers, Alan R.; Jan. 08, 1999; 7p; In English
Contract(s)/Grant(s): N00014971G008
Report No.(s): AD-A359465; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche
Selected incoming freshmen "at risk" students were admitted to the Engineering and Science Summer Research Program with the intent of introducing these students to the classroom and research environment at Vanderbilt University, in addition to presenting to them the wide range of professional opportunities available. Participants also included high school teachers and counselors (previous program participants). The program included workshops, courses, computer skills, field trips, and research projects designed to enhance the probability of academic success. The program appears to have been successful in increasing the academic performance of this group of "at risk" students.
DTIC
Engineering; Probability Theory; Instructors; Risk

84
LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes: aviation law; space law and policy; international law; international cooperation; and patent policy

19980092837
Interpretation and development of the UN safety principles for space nuclear power sources
Wade, Brian, Foxdown Technology, UK; 1997, pp. 1335-1340; In English; Copyright; Avail: AIAA Dispatch
In adopting a resolution on 'principles relevant to the use of nuclear power sources in outer space' in December 1992, the UN General Assembly recognized that future revision would be required in view of emerging nuclear power applications in space and evolving international recommendations on nuclear safety and radiological protection. A revision is suggested which generalizes the intentions embodied in the UN resolution in a way which is consistent with subsequent international developments under the aegis of ICRP and IAEA. The revision takes the form of six Supplementary Principles incorporating developments in probabilistic risk assessment, safety culture, and radiological protection together with the recognition of the importance of safeguards.
Author (AIAA)
Space Power Reactors; Nuclear Reactors; United Nations; Reactor Safety

19990067885
Use of importance measures in risk-informed regulatory applications
Cheok, Michael C., US Nuclear Regulatory Commission, USA; Parry, Gareth W.; Sherry, Richard R.; Reliability Engineering & System Safety; Jun, 1998; ISSN 0951-8320; Volume 60, no. 3, pp. 213-226; In English; Copyright; Avail: Issuing Activity
The use of importance measures to analyze PRA results is discussed. Commonly used importance measures are defined. Some issues that have been identified as potentially limiting their usefulness are addressed, namely: there is no simple relationship between importance measures evaluated at the single component level and those evaluated at the level of a group of components, and, as a result, some of the commonly used importance measures are not realistic measures of the sensitivity of the overall risk to parameter value changes; and, importance measures do not typically take into account parameter uncertainties which raises the question of the robustness of conclusions drawn from importance analyses. The issues are explored in the context of both ranking

and categorization of structures, systems, and components (SSCs) with respect to risk-significance and safety-significance for use in risk-informed regulatory analyses.
Author (EI)
Assessments; Risk; Law (Jurisprudence); Probability Theory; Mathematical Models

19990068073
Public perception versus results of scientific risk analysis
Cohen, Bernard L., Univ. of Pittsburgh, USA; Reliability Engineering & System Safety; Jan, 1998; ISSN 0951-8320; Volume 59, no. 1, pp. 101-105; In English; Copyright; Avail: Issuing Activity

Using nuclear power as an example, it is shown without any controversial arguments that public perception can be completely out of touch with the results of scientific risk analysis. Evidence is presented which indicates that the direct responsibility for this is in the refusal of the media to transmit the relevant information, especially about probabilities, and the underlying responsibility is in the political agenda of environmental groups. My analysis of the reasons for this is presented. The history of the battle for public perception of nuclear power is recounted.
Author (EI)
Risk; Accidents; Nuclear Reactors; Probability Theory

85
TECHNOLOGY UTILIZATION AND SURFACE TRANSPORTATION

Includes aerospace technology transfer; urban technology; surface and mass transportation. For related information see 03 Air Transportation and Safety, 16 Space Transportation and Safety, and 44 Energy Production and Conversion. For specific technology transfer applications see also the category where the subject is treated.

19980041449 Wright Lab., Wright-Patterson AFB, OH USA
Theoretical Technology Transfer Measures from Risk Management ***Final Report, 1 Mar. 1996 - 1 Oct. 1997***
Jines, Lanny A., Wright Lab., USA; Oct. 1997; 100p; In English
Report No.(s): AD-A337330; WL-TR-97-6011; No Copyright; Avail: CASI; A05, Hardcopy; A02, Microfiche

This study addresses the goal of managing the future by combining a promising metric, strategic planning, probability encoding, risk management, and the Taguchi Design of Experiments technique into a new 'out of the box' methodology for program management. Although the methodology is applicable to many large programs, the USA military technology transfer program partnering Department of Defense laboratories with civilian industries was chosen as the focus for the demonstration. The method demonstrated goes beyond current documented attempts at metric development within the federal program. The result of the research yields useful management information for the technology transfer activity of the Air Force Wright Laboratory. Transferring military technology to civilian industry results in products and services solving deficiencies in food supply, shelter, education, health care, transportation and recreation while simultaneously contributing toward the attaintment of national employment goals yet assuring new capabilities for civil security and national defense. The Wright Laboratory investment in mission related research and development programs which also show promise for potential future technology transfer will benefit from informed management making good decisions. The ability to predict the necessary investment funds to accomplish Cooperative Research and Development Agreements through a method capable of measurement b y a proposed metric results from this Program Demonstrating Excellence. This new theoretical approach toward management of federal laboratory research and development programs results in a new methodology grounded in the theory of risk analysis capable of addressing uncertainty as found in technology transfer.
DTIC
Technology Transfer; Research Management; Probability Theory; Coding; Experiment Design; Management Planning; Risk

90
ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.

19890011931 Arizona Univ., Planetary Science Inst., Tucson, AZ, USA
Risk to civilization: A planetary science perspective
Chapman, Clark R., Arizona Univ., USA; Morrison, David, Arizona Univ., USA; Lunar and Planetary Inst., Global Catastrophes

in Earth History: An Interdisciplinary Conference on Impacts, Volcanism, and Mass Mortality; Jan 1, 1988, pp. p 26-27; In English; See also N89-21287 14-42; Prepared in cooperation with Hawaii Univ., Honolulu; Avail: CASI; A01, Hardcopy; A03, Microfiche

One of the most profound changes in our perspective of the solar system resulting from the first quarter century of planetary exploration by spacecraft is the recognition that planets, including Earth, were bombarded by cosmic projectiles for 4.5 aeons and continue to be bombarded today. Although the planetary cratering rate is much lower now than it was during the first 0.5 aeons, sizeable Earth-approaching asteroids and comets continue to hit the Earth at a rate that poses a finite risk to civilization. The evolution of this planetary perspective on impact cratering is gradual over the last two decades. It took explorations of Mars and Mercury by early Mariner spacecraft and of the outer solar system by the Voyagers to reveal the significance of asteroidal and cometary impacts in shaping the morphologies and even chemical compositions of the planets. An unsettling implication of the new perspective is addressed: the risk to human civilization. Serious scientific attention was given to this issue in July 1981 at a NASA-sponsored Spacewatch Workshop in Snowmass, Colorado. The basic conclusion of the 1981 NASA sponsored workshop still stands: the risk that civilization might be destroyed by impact with an as-yet-undiscovered asteroid or comet exceeds risk levels that are sometimes deemed unacceptable by modern societies in other contexts. Yet these impact risks have gone almost undiscussed and undebated. The tentative quantitative assessment by some members of the 1981 workshop was that each year, civilization is threatened with destruction with a probability of about 1 in 100,000. The enormous spread in risk levels deemed by the public to be at the threshold of acceptability derives from a host of psychological factors that were widely discussed in the risk assessment literature. Slovic shows that public fears of hazards are greatest for hazards that are uncontrollable, involuntary, fatal, dreadful, globally catastrophic, and which have consequences that seem inequitable, especially if they affect future generations.

CASI

Assessments; Destruction; Hazards; Meteorite Collisions; Planets; Probability Theory; Psychological Factors; Risk

99
GENERAL

Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs such as Apollo, Gemini, and Mercury spacecraft, Earth Resources Technology Satellite (ERTS), and Skylab; NASA appropriations hearings.

19690058019

The development and application of a methodology of program risk evaluation.

Herrmann, C. R.; Ingram, G. E.; Welker, E. L.; Jan 1, 1969; 9p; In English; ANNALS OF ASSURANCE SCIENCES, JUL. 7-9, 1969, DENVER, COLO.; CONFERENCE SPONSORED BY THE AMERICAN INST. OF AERONAUTICS AND ASTRONAUTICS, THE SOCIETY OF AUTOMOTIVE ENGINEERS, AND THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.; Copyright; Avail: Issuing Activity

R and D program risk evaluation methodology in density functions form for program goals probabilities, noting random variables as parameters

AIAA

Management Planning; Probability Theory; Reliability Engineering; Research and Development; Risk

19720051674

Evaluating alternate paths in R & D project planning.

Howard, E. M.; Yule, W. G., Jr., IBM Corp., USA; IEEE Transactions on Engineering Management; Aug 1, 1972; EM-19, pp. Aug. 197; In English; p. 86-92; Copyright; Avail: Issuing Activity

It is shown that R and D project planning comes down to the assessment of risk, and the subjective probabilities needed for risk analysis are illustrated. It is pointed out that methods exist for handling complicated problems in probability, once the underlying R and D problem is defined, interdependences are established, and the required times, costs, and subjective probabilities are estimated.

AIAA

Probability Theory; Project Planning; Research and Development; Risk

19740020341 Joint Publications Research Service, Arlington, VA, USA

Risk, conflict, and uncertainty in decision making and in its simulation

Rudashevskiy, V. D., Joint Publications Research Service, USA; Jun 10, 1974; 16p; Transl. into ENGLISH from Vop. Psikhologii (Moscow), no. 2, 1974 p 84-94; In English

Report No.(s): JPRS-62211; Avail: CASI; A03, Hardcopy; A01, Microfiche

An analysis of the dominant role in the process of decision making which is played by such psychological components of the problematic situation as risk, conflict, and uncertainty was conducted. It is stated that the flow of information on the basis of these factors may serve as a universal indicator of psychological processes. Since this indicator can be measured, it may serve as an indispensable instrument for accurate perception of sociopsychological models and their transposition to the level of engineering-psychological models. The application of games theory to investigations on optimum behavior is reported. The interaction of the external environment and the previous experience of the subject is analyzed.

CASI

Decision Making; Game Theory; Probability Theory; Psychological Factors; Risk

Subject Term Index

A

ACCEPTABILITY, 36
ACCIDENT PREVENTION, 11, 12, 13, 20, 30, 39, 40, 41, 43, 44, 47
ACCIDENTS, 9, 33, 36, 40, 44, 49
ACCOUNTING, 37
AERONAUTICS, 2
AEROSPACE ENGINEERING, 3, 46
AEROSPACE SAFETY, 4, 5, 8, 10, 45
AEROSPACE SYSTEMS, 7
AEROSPACE VEHICLES, 8
AGING (METALLURGY), 23
AIR TRANSPORTATION, 1
AIRCRAFT ACCIDENTS, 11
AIRCRAFT MAINTENANCE, 22
AIRCRAFT SAFETY, 11, 22
ALGORITHMS, 12, 16, 34, 38
AMBIGUITY, 32
APPLICATIONS PROGRAMS (COMPUTERS), 12, 22
APPROXIMATION, 33
ARID LANDS, 21
ASSESSMENTS, 3, 4, 5, 11, 12, 13, 14, 16, 18, 20, 21, 29, 30, 35, 37, 38, 39, 40, 41, 43, 44, 49, 50
ASYMPTOTIC PROPERTIES, 29
AUXILIARY POWER SOURCES, 5, 18

B

BANACH SPACE, 35
BAYES THEOREM, 38, 39
BINOMIALS, 15
BOILING WATER REACTORS, 13, 44
BOOLEAN ALGEBRA, 39
BOOLEAN FUNCTIONS, 39
BREATHING APPARATUS, 24
BUILDINGS, 19

C

C–141 AIRCRAFT, 22, 23
CANCER, 24
CARBON FIBERS, 10
CASSINI MISSION, 3
CHEBYSHEV APPROXIMATION, 29
CLASSIFICATIONS, 29
CODING, 49
COMBUSTION, 10
COMMUNICATION NETWORKS, 27
COMPLEX SYSTEMS, 41
COMPONENT RELIABILITY, 14
COMPUTATION, 12, 21
COMPUTER AIDED DESIGN, 46
COMPUTER INFORMATION SECURITY, 7, 27, 41
COMPUTER NETWORKS, 27
COMPUTER PROGRAM INTEGRITY, 28
COMPUTER PROGRAMS, 12, 22, 23, 24, 28, 34, 35
COMPUTER SYSTEMS PERFORMANCE, 28
COMPUTER SYSTEMS PROGRAMS, 47
COMPUTER TECHNIQUES, 30
COMPUTERIZED SIMULATION, 11, 21, 33, 38
CONCURRENT ENGINEERING, 45
CONFERENCES, 7, 17
CONFIDENCE LIMITS, 31
CONTROL EQUIPMENT, 26
COST EFFECTIVENESS, 46
COVARIANCE, 35
CRACK INITIATION, 17, 18, 19
CRACK PROPAGATION, 18
CRACKING (FRACTURING), 23
CRACKS, 22
CRASHES, 11
CULTURE (SOCIAL SCIENCES), 30

D

DAMAGE ASSESSMENT, 5, 22, 23
DAMPING, 14
DATA BASE MANAGEMENT SYSTEMS, 14
DATA BASES, 48
DATA PROCESSING, 25
DATA RETRIEVAL, 25
DATA STORAGE, 25
DECISION MAKING, 13, 31, 32, 34, 37, 38, 40, 41, 45, 47, 51
DECISION THEORY, 2, 21, 26, 27, 38
DECOMPRESSION SICKNESS, 24
DEGRADATION, 43
DESIGN ANALYSIS, 15, 28, 45
DESTRUCTION, 50
DISPLAY DEVICES, 26
DIVING (UNDERWATER), 24
DYNAMIC STRUCTURAL ANALYSIS, 11

E

EARTHQUAKE RESISTANCE, 21
ECOLOGY, 20
ECONOMIC FACTORS, 36
ECONOMIC IMPACT, 33
ECONOMICS, 30
ECOSYSTEMS, 20
EDUCATION, 47
ELECTRIC POWER, 5
EMERGENCIES, 33
ENERGY TECHNOLOGY, 19
ENGINE PARTS, 18
ENGINEERING, 48
ENGINEERING MANAGEMENT, 34, 45
ENGINES, 14
ENVIRONMENT EFFECTS, 33
ENVIRONMENTS, 42
ERROR ANALYSIS, 2, 24, 25
ERROR FUNCTIONS, 29
ERRORS, 32
ESTIMATING, 31, 45
EVALUATION, 28
EXPERIMENT DESIGN, 49

F

FAILURE, 8, 15, 16, 29, 33, 36
FAILURE ANALYSIS, 2, 5, 7, 13, 18, 37, 39, 41
FAILURE MODES, 1, 7, 19, 26, 38, 48
FATIGUE TESTS, 19
FAULT TREES, 12, 17, 25, 35
FEEDBACK CONTROL, 2
FINITE ELEMENT METHOD, 16
FIRE PREVENTION, 3, 8
FIRES, 8, 10, 11, 13
FLIGHT HAZARDS, 1
FLIGHT SAFETY, 1, 4
FLUID FLOW, 10
FORMULATIONS, 36
FRACTURE MECHANICS, 43
FUZZY SETS, 30

G

GAME THEORY, 21, 35, 51
GEOLOGY, 20
GEOMETRY, 18
GROUND BASED CONTROL, 26
GROUP DYNAMICS, 21

H

HAZARDS, 9, 10, 29, 40, 50
HEAT SOURCES, 8
HEAT TRANSFER, 10
HUMAN FACTORS ENGINEERING, 24, 26, 42
HUMAN PERFORMANCE, 25, 32, 42
HUMAN–COMPUTER INTERFACE, 26

I

INDUSTRIES, 43
INFERENCE, 32
INFORMATION SYSTEMS, 25
INSPECTION, 17, 22
INSTRUCTORS, 48
INSURANCE (CONTRACTS), 29
INTELLECTUAL PROPERTY, 7

J

JOINTS (JUNCTIONS), 22
JUDGMENTS, 34

K

KNOWLEDGE REPRESENTATION, 34

L

LASERS, 8
LAUNCH VEHICLES, 9, 10, 26, 38
LAW (JURISPRUDENCE), 49
LIFE CYCLE COSTS, 45
LIGHT WATER REACTORS, 14
LIKELIHOOD RATIO, 34
LINEAR PROGRAMMING, 27
LOGIC DESIGN, 44
LOW EARTH ORBITS, 8

M

MAINTAINABILITY, 17
MAINTENANCE, 17, 34, 42, 43
MAN MACHINE SYSTEMS, 24, 28
MANAGEMENT, 38
MANAGEMENT INFORMATION SYSTEMS, 26
MANAGEMENT METHODS, 3, 45, 46
MANAGEMENT PLANNING, 49, 50
MANUALS, 15
MARKOV PROCESSES, 42, 43
MATHEMATICAL MODELS, 9, 10, 13, 15, 21, 29, 30, 33, 34, 38, 43, 49
MEASURING INSTRUMENTS, 26
MECHANICAL DEVICES, 15
MENTAL PERFORMANCE, 34
METAL FATIGUE, 22
METEORITE COLLISIONS, 50
METHODOLOGY, 6
MICROGRAVITY, 3
MILITARY OPERATIONS, 22
MINIMAX TECHNIQUE, 35
MISSILES, 21
MISSION PLANNING, 8, 10, 45
MONTE CARLO METHOD, 3, 35
MOTOR VEHICLES, 14
MULTIVARIATE STATISTICAL ANALYSIS, 16, 37

N

NASA PROGRAMS, 4, 6, 46
NASA SPACE PROGRAMS, 48
NATURAL GAS, 14
NEURAL NETS, 29
NONDESTRUCTIVE TESTS, 17
NORMALITY, 31
NUCLEAR ELECTRIC POWER GENERATION, 43
NUCLEAR POWER PLANTS, 20, 25, 26, 32, 33, 36
NUCLEAR REACTOR CONTROL, 26
NUCLEAR REACTORS, 26, 40, 42, 43, 44, 48, 49
NUMERICAL ANALYSIS, 37

O

OPERATIONS RESEARCH, 42, 44
OPERATORS (PERSONNEL), 25
OPTIMIZATION, 30, 40, 41

P

PARAMETER IDENTIFICATION, 33, 38
PATTERN RECOGNITION, 12
PERFORMANCE PREDICTION, 5
PERSONNEL, 38
PIPES (TUBES), 14
PLANETS, 50
PLUTONIUM, 4
POISSON DENSITY FUNCTIONS, 29
POLICIES, 13, 47
POLLUTION TRANSPORT, 33
POPULATIONS, 35
PREDICTION ANALYSIS TECHNIQUES, 17
PREDICTIONS, 6, 44
PRESSURE, 19
PRESSURE REDUCTION, 24
PRESSURE VESSELS, 11, 43
PRESSURIZING, 3
PRIORITIES, 46
PROBABILITY THEORY, 1, 2, 3, 5, 6, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51
PRODUCT DEVELOPMENT, 46
PROJECT MANAGEMENT, 46, 47
PROJECT PLANNING, 50
PROPULSION, 3
PROPULSION SYSTEM CONFIGURATIONS, 10
PSYCHOLOGICAL FACTORS, 50, 51
PSYCHOLOGY, 32
PUBLIC HEALTH, 36

R

RADIATION DOSAGE, 8
RADIATION HAZARDS, 4, 9
RADIATION SHIELDING, 43
RANDOM PROCESSES, 20
REACTOR CORES, 44
REACTOR DESIGN, 26
REACTOR SAFETY, 14, 25, 33, 35, 36, 48
REAL TIME OPERATION, 24
REDUNDANT COMPONENTS, 17
REGIONAL PLANNING, 41
RELIABILITY, 15, 16, 25, 28, 37, 39, 41, 42, 43
RELIABILITY ANALYSIS, 6, 15, 16, 22, 25, 28, 32, 41, 42
RELIABILITY ENGINEERING, 11, 17, 36, 37, 48, 50
RESEARCH AND DEVELOPMENT, 50
RESEARCH MANAGEMENT, 49
RESOURCE ALLOCATION, 11
RESPONSE BIAS, 34
RISK, 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51
ROOMS, 26
ROTATING DISKS, 17

S

SAFETY, 14, 22, 25, 36, 45
SAFETY FACTORS, 1, 2, 3, 4, 36, 45
SAFETY MANAGEMENT, 1, 4, 11, 36
SAMPLING, 31, 39
SEISMIC WAVES, 14
SEISMOLOGY, 20
SELECTIVE DISSEMINATION OF INFORMATION, 27

SHUTDOWNS, 9
SOFTWARE ENGINEERING, 28, 47
SOFTWARE RELIABILITY, 47
SPACE COMMERCIALIZATION, 1
SPACE COMMUNICATION, 7
SPACE DEBRIS, 8
SPACE FLIGHT, 3, 9
SPACE POWER REACTORS, 42, 48
SPACE SHUTTLE BOOSTERS, 5, 6
SPACE SHUTTLE MAIN ENGINE, 5, 6, 9, 18
SPACE SHUTTLE ORBITERS, 6
SPACE SHUTTLE PAYLOADS, 9
SPACE SHUTTLES, 3, 4, 5, 6, 7, 17, 45
SPACE STATION FREEDOM, 4, 26
SPACE STATIONS, 3, 4, 10, 41
SPACE TRANSPORTATION, 1
SPACE TRANSPORTATION SYSTEM, 18
SPACECRAFT DESIGN, 42
SPACECRAFT PROPULSION, 9
SPACECRAFT RELIABILITY, 1, 5, 6, 9
SPACECREWS, 26
STATISTICAL ANALYSIS, 10, 14, 15, 21, 35, 38
STATISTICAL DISTRIBUTIONS, 36
STOCHASTIC PROCESSES, 14, 20, 29, 36
STRESS CORROSION CRACKING, 17, 22
STRUCTURAL ANALYSIS, 18, 21, 22, 23, 43
STRUCTURAL DESIGN, 16, 18
STRUCTURAL ENGINEERING, 30
STRUCTURAL MEMBERS, 18
STRUCTURAL RELIABILITY, 16, 17, 19
SURVIVAL, 26
SYSTEM FAILURES, 6, 14
SYSTEMS ANALYSIS, 16, 41
SYSTEMS ENGINEERING, 10, 44, 45
SYSTEMS STABILITY, 18

T

TASK COMPLEXITY, 24
TECHNOLOGY ASSESSMENT, 19
TECHNOLOGY TRANSFER, 45, 49
TEMPERATURE DISTRIBUTION, 21
TESTING TIME, 15
THERMAL ENVIRONMENTS, 11
THERMAL PROTECTION, 6
THERMAL SHOCK, 43
THERMOELECTRIC GENERATORS, 8
THERMONUCLEAR REACTIONS, 44
TOLERANCES (MECHANICS), 22
TOTAL QUALITY MANAGEMENT, 30
TRAINING AIRCRAFT, 22
TRAJECTORY OPTIMIZATION, 2
TRANSPORT AIRCRAFT, 23
TURBINE WHEELS, 18

U

ULTRASONICS, 17
ULYSSES MISSION, 4, 8, 9
UNITED NATIONS, 48
USER MANUALS (COMPUTER PROGRAMS), 23

V

VARIABILITY, 35
VIBRATION MODE, 43
VULNERABILITY, 33

W

WEAPON SYSTEM MANAGEMENT, 22
WEIBULL DENSITY FUNCTIONS, 15
WIND TUNNELS, 19
WINGS, 22
WORDS (LANGUAGE), 37

Personal Author Index

A

Ahlbrecht, Martin, 37
Alford, R. E., 22
Alpert, D. J., 33
Anello, C., 29
Apostolakis, G., 3, 8, 15, 32
Appignani, Peter L., 4, 5
Arnett, L. M., 22
Augusti, G., 30

B

Baborovsky, V. M., 16
Ballesio, Jorge, 4, 5
Banning, Douglas W., 8
Barlow, R. E., 31
Bell, R. P., 22
Bell, S., 3
Benjamin, A. S., 28
Berens, A. P., 22
Berens, Alan P., 23
Bhat, Jayaram K., 12
Biggs, R. E., 9
Bishop, Bruce A., 43
Bogen, K. T., 35
Bohnenblust, Hans, 47
Bontempo, Robert N., 30
Bottom, William P., 30
Bowers, Alan R., 48
Bowlin, Samuel W., 27
Bream, B., 3
Brown, N. N., 28
Bruske, S. Z., 41
Bubb, Heiner, 40
Buchbinder, Ben, 2, 26
Bukowski, R. W., 10
Burke, R. P., 33
Burns, Edward T., 12
Burns, J. G., 22
Byers, J. C., 25

C

Cadwallader, L. C., 44
Campbell, J., 16
Carter, Robert G., 43
Catton, I., 3, 8
Chamis, C. C., 16, 18
Chamis, Christos C., 18
Chapman, Clark R., 49
Charnes, A., 27
Chen, J. C., 20
Cheok, M. C., 38
Cheok, Michael C., 48
Chu, J., 21
Cochran, J. B., 22
Cohen, Bernard L., 49
Collins, Erin P., 4, 5
Comer, K., 25
Cooper, J. Arlin, 36
Cooper, W. W., 27
Croach, J. W., 22
Cross, Frank B., 13
Cruse, T. A., 18

D

Daniel, Sharon L., 34
Danielson, Mats, 38
Davis, T. C., 15
DeJong, Jac, 13
Dhar, Subrato, 23
Donovan, M., 25
Dowling, J. P., Jr., 26
Dunn, W. L., 21
Dunning, D. E., Jr., 23

E

Einhorn, H. J., 32
Einhorn, Hillel J., 34
Ekenberg, Love, 38
Englehardt, James D., 19
Erdahl, David C., 8

F

Ferson, S., 36
Finizio, C., 2
Fishburn, P. C., 30
Fitch, L. R., 27
Fleming, K. N., 40
Fletcher, Sharon K., 28
Fragola, Joseph R., 4, 5, 7, 37
Frank, M. V., 7
Frank, Michael V., 4, 5, 9
Frees, E. W., 32
Friedman, David M., 14
Friedman, Seymour L., 37
Frisch, Brigitta, 46
Fullwood, R. R., 1

G

Gallagher, Joseph P., 23
Galyean, W. J., 25
Gamble, Ronald M., 43
Gasemyr, J., 37
Geaslen, W. D., 41
Gerez, L., 9
Gerez, Luis, 4, 5
Gertman, D. I., 25
Ginzburg, L., 36
Glaser, Peter E., 10
Grayson, A. S., 44
Gross, D., 10
Grosse, Larry, 13
Gull, M. J., 16
Guttmann, H. E., 24

H

Hackerott, Alan, 12
Hadlock, Charles R., 10
Haim, M., 15
Hall, R. E., 1
Hammer, Theodore F., 46, 47
Hammond, D. O., 22
Harris, B., 14
Hauptmanns, U., 30
Heger, A. Sharif, 12
Herrmann, C. R., 50
Hill, D. J., 43
Hill, Richard A., 12
Hoffman, Chad R., 6, 17
Hogarth, R. M., 32
Hogarth, Robin M., 34
Hollander, J. M., 19
Holmberg, Jan, 36
Horman, R. L., 25
Houben, R. J., 36, 39
Hovey, Peter W., 23
Howard, E. M., 50

I

Iba, T., 43
Ingram, G. E., 50
Irwin, P. A., 19
Issacci, F., 3, 8

J

Jaquith, Susan C., 12
Jines, Lanny A., 49
Johanson, Gunnar, 36
Johnson, Gary L., 3
Johnson, J. J., 20
Jones, S., 3, 8

K

Kadioglu, Mikdat, 21
Kaiser, G. D., 33
Kaplan, Stan, 4, 37
Kappos, A. J., 20
Karns, James J., 4, 5, 6
Kelly, Dana L., 38
Knessl, Charles, 29
Kolarik, William J., 42
Kozinsky, E. J., 24
Krueger, Gregory A., 12
Krzensk, Udo, 35
Kukielka, Casimir A., 44

L

Lafollette, John P., 15
Lanclos, H. J., 44
Landers, Thomas L., 42
Leggett, R. W., 23
Leonard–Hood, Dana, 26
Lincoln, John W., 22
Loomis, John S., 23

M

Maggio, G., 9
Maggio, Gaspare, 4, 5, 6, 37
Marquis, D. G., 21
Marshall, A. W., 29
Marshall, N. H., 27
Martinez–Guridi, G., 1
Martz, Harry F., 35, 39
Maslov, Sergei, 40
Mcclung, R. C., 18
Mcfadden, Richard H., 4, 5
Mensing, R. W., 33
Meyer, Theodore A., 43
Miller, D. P., 25
Miller, D. R., 10
Morera, Osvaldo, 34
Moriyama, K., 43
Morrison, David, 49
Morrissey, Stephen J., 45
Mosleh, A., 3, 32
Moya, J. L., 11
Mrowca, Bruce, 12
Mulvihill, R. J., 3
Murphy, John, 13

N

Nagpal, V. K., 18
Nanba, H., 43
Natvig, B., 37
Nelson, W. R., 25
Nertney, R. J., 25
Niemelae, Ilkka, 36
Nygren, Thomas E., 34

O

Okazaki, A., 43
Olkin, I., 29
Ostmeyer, R. M., 33
Ostrom, L. T., 25
Ozaki, M., 43

P

Paez, T. L., 28
Painton, L., 16
Palmieri, S., 2
Panicucci, M., 11
Parry, G. W., 32, 38
Parry, Gareth W., 48
Paul, M., 8
Paulos, T., 3, 8
Paxton, K., 3, 8
Payne, Arthur C., Jr., 34
Peltonen, P., 11
Peters, Craig Steven, 29
Picard, Richard R., 39
Pittman, R. Bruce, 45
Poucet, A. E., 44
Prairie, R. R., 31
Preyssl, C., 11
Preyssl, Christian, 46
Priddy, T. G., 11
Pugh, Rich, 6, 17

Q

Quinzi, A. J., 31

R

Ragland, W. A., 43
Rasmuson, D. M., 27, 33
Reitz, H. J., 21
Riccucci, A., 2
Ritchie, L. T., 33
Robinson, R. C., 33
Rogers, Christopher W., 26
Roglans, J., 43
Rosenberg, Linda, 46, 47
Rudashevskiy, V. D., 51
Rudolph, K., 3
Runkle, G. E., 33
Russell, K. D., 33
Rutledge, Pete, 26
Ryan, Thomas G., 41

S

Safie, Fayssal, 6, 17
Sakawa, M., 41
Samanta, P., 42
Sankar, S., 39
Sarper, Hueseyin, 46
Satoh, R., 43
Sattison, M. B., 33
Schneider, Raymond E., 12
Selroos, Jan–Olof, 20
Sen, Zekai, 21
Seo, F., 41
Seya, H., 43
Shah, A. R., 18
Shaw, Thomas E., 45
Shen, M.–H. H., 18
Shen, Minsheng, 18
Shepherd, J. C., 27
Sherry, R. R., 38
Sherry, Richard R., 48
Shiao, M. C., 18
Shiao, Michael C., 18
Shieh, L. C., 20
Sifton, V. L., 19
Simmons, M. K., 19
Simon, Elvis D., 8
Siu, Nathan O., 38
Skocypec, R. D., 11
Slovic, Paul, 40, 47
Smidts, C., 3, 28
Smith, P. D., 20
Smith, T. M., 31
Soland, R. M., 10
Stack, Desmond W., 12
Stadje, Wolfgang, 42
Stock, D., 42
Stolle, Frank, 46
Straeter, Oliver, 40
Strait, R. S., 45

Survanshi, S. S., 24
Swain, A. D., 24
Swaminathan, S., 3, 28

T

Talbott, Dale V., 12
Taylor, Charles R., 8
Taylor, N. P., 44
Thaggard, Michael, 47
Thalmann, E. D., 24
Thomas, R. E., 31
Thomas, R. K., 11
Tomomoto, K., 43
Torng, T. Y., 18
Twisdale, L. A., 21
Twisdale, Lawrence A., 15

U

Ugata, T., 43

V

van Hengel, W., 39
Van–Halle, J. –Y., 3
Vanhengel, W., 36
Vansiclen, V. S., 33
Varde, P. V., 39
Verma, A. K., 39
Vesely, W., 42
Vesely, W. E., 15, 39
Vrijling, J. K., 36, 39

W

Wade, Brian, 48
Ware, A. G., 13
Weathersby, P. K., 24
Weber, Elke U., 30
Weber, Martin, 37
Welker, E. L., 50
Wells, J. E., 20
Wells, James E., 3
Wessels, J. F. M., 36
White, Edward J., 48
Wild, Antonin, 17
Wilhelmsen, C. A., 25
Williams, L. R., 23
Winter, P. W., 32
Wiskerchen, Michael J., 45
Wojcik, Leonard A., 1
Wood, D. O., 19
Woodard, K., 33
Wright, R. E., 41

Y

Yule, W. G., Jr., 50

Z

Zhang, Yi–Cheng, 40
Zuber, Laura C., 14