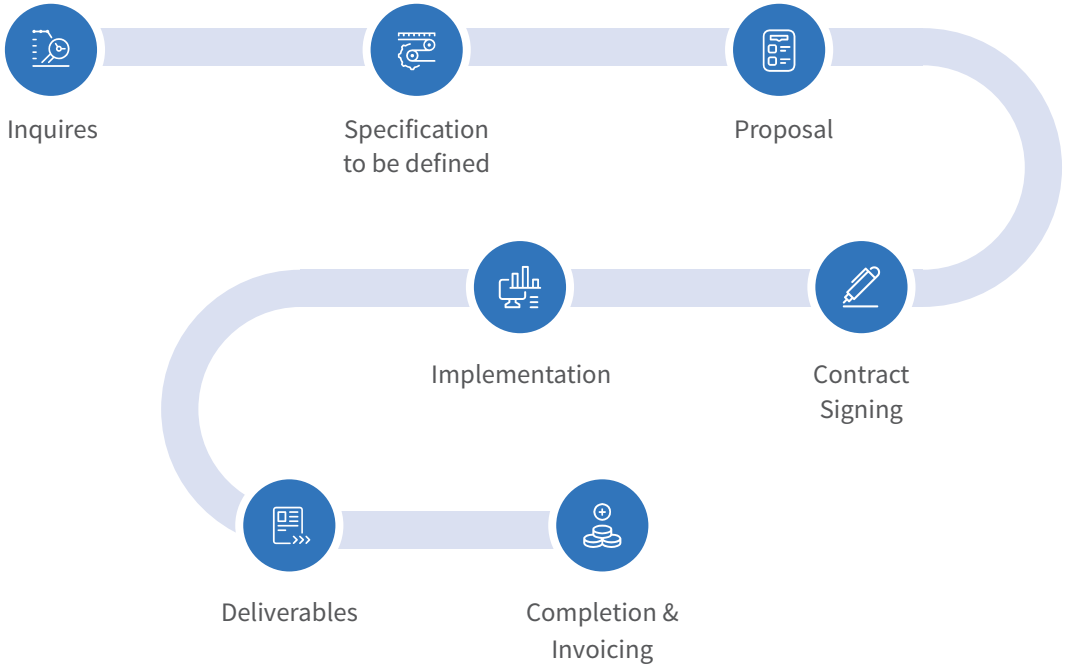
Solutions to Your Challenges

Platform for collaboration and services

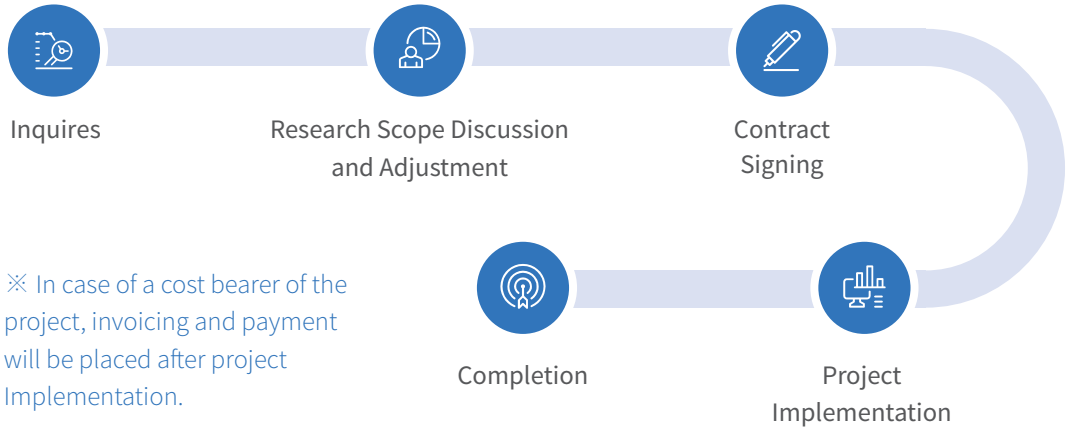
Our expertise and experience can benefit your business in various ways.

- **Consulting and Information (C&I)**
- **Licensing software and patents**
- **Testing and qualification**
- **Training and Seminar**
- **Joint research**
- **Research reports**

Consulting and Information (C&I)
Testing and qualification



Joint research



※ In case of a cost bearer of the project, invoicing and payment will be placed after project Implementation.

> Consulting and Information (C&I)

Understanding the Remaining Life of the Critical Component for Thermal Power

Remaining Life Assessment of 9Cr Steel Pipe Using Miniature Sample Technology

Overcoming Your Challenges

To assess the remaining life of 9Cr Steel Pipe Using Miniature Sample Technology

Why CRIEPI?

We cut out a small sample from 9Cr steel pipe material and conduct an analysis of microstructure as well as a creep test. We evaluate the results by utilizing our database of materials used for ultrasupercritical facility and assess the remaining life of the 9Cr steel pipe (the base material and welded joint).

Our Equipment

Spherical Aberration-corrected Transmission Electron Microscope

CRIEPI's Achievements

We contributed to the revision of the creep life evaluation curve for high chromium steel welded joint (Committee of the Federation of Electric Power Companies of Japan)

References:

- Creep Life Assessment Method for Welded Joint of Grade 91 Steel Using Small Sample, Joint EPRI-123HiMAT International Conference on Advances in High Temperature Materials, 2019, pp.1294-1304
- Yaguchi et al., ASME PVP 2016-63316 (2016)
- CRIEPI Research Report Q14002 (2014)
- CRIEPI Annual Report FY2016 (2017), pp.28-29

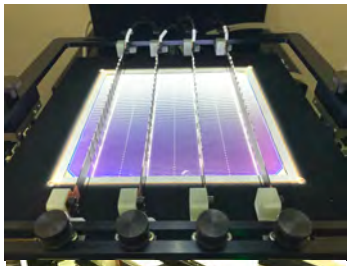
Performance and Reliability of Solar Cell Modules in Outdoor Environments

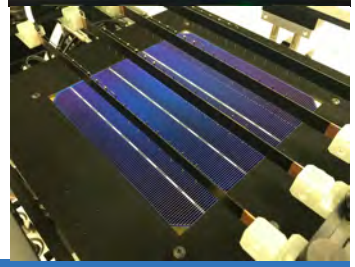
We evaluate the power generation performance and long-term reliability of various solar cell modules under outdoor conditions in Japan (Akagi City, Gunma Prefecture).

Consulting Services for Advanced Analysis of Solar Cell Power Generation Performance

We offer consulting services related to technology for advanced analysis of solar cell power generation performance by extracting only highly accurate measurement data (big data) from photovoltaic power generation systems and solar cell modules.

Performance measurements of PV systems composed of various PV technologies at the Akagi Testing Center





High precision solar simulator for solar cells using xenon short arc lamp

Keywords

- Photovoltaic (PV)
- Photovoltaic modules
- Reliability
- Big data
- Statistical techniques

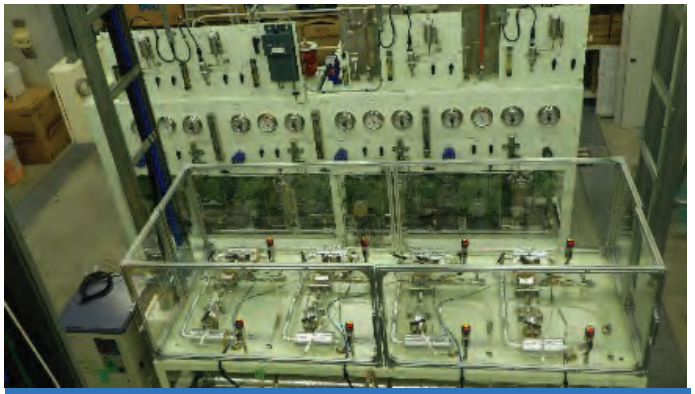
References:

T. Ishii and A. Masuda, Annual degradation rates of recent crystalline-silicon photovoltaic modules, Progress in Photovoltaics: Research and Applications (2017), 25(12), 953-967

T. Ishii, R. Sato, S. Choi, Y. Chiba, and A. Masuda, Development of a practical method of estimating electric power from various photovoltaic technologies with high precision, Japanese Journal of Applied Physics (2017), 56(8S2), 08MD05

Investigation of Flow Accelerated Corrosion (FAC) Behavior in Carbon Steel

We will investigate flow accelerated corrosion (FAC) behavior of carbon steel in liquid single-phase flow at high flow velocities. Possible test parameters include temperature, flow velocity, and water chemistry (pH and dissolved oxygen concentration).



High flow velocity and high temperature loop system for corrosion evaluation

References:

K.Fujiwara, K. Yoneda, F. Inada, "Effect of Dissolved Oxygen on Flow-Accelerated Corrosion in Neutral and Alkaline Solutions", Proc. EUROCORR 2017, 78701 (2017).

K. Fujiwara, Y. Uchiyama, K. Yoneda, F. Inada, Proc. 21st International Conference on Water Chemistry in Nuclear Reactor Systems (2018).

Keywords

Flow accelerated corrosion

Feed water piping

Carbon steel

Dissolved oxygen

Testing Ceramic Melter Performance for Radioactive Waste Management

We will conduct vitrification tests using our small-scale Joule-Heated Ceramic Melter.

We will produce vitrified glass by continuously feeding simulated radioactive waste and glass material from the top of the molten glass in the ceramic melter and removing the molten glass from the bottom of the ceramic melter and cooling it.

Tests using this facility are effective for analyzing the formation state of the cold cap on the melted surface, the properties of the vitrified product, and the off-gas migration behavior during glass melting.

“Please” note that we do not perform tests that handle radioactive materials.

Vitrification experiments using small-scale glass melter

References:

CRIEPI Annual Report FY2017(2018), pp.26-27

K. Uruga, T. Tsukada, T. Usami, “Generation mechanism and prevention method of secondary molybdate phase during vitrification of PUREX wastes in liquid-fed ceramic melter,”J. Nucl. Sci. Technol., 57(4), 433-443 (2020).

K. Uruga, T. Tsukada, T. Usami et al., “STUDY FOR GENERATION OF YELLOW PHASE USING SMALL SCALE JOULE HEATING MELTER,”GLOBAL2015, 5191, Paris, France (2015).

Keywords

Vitrification

Radioactive waste

Cold cap

Volatilization

SIRIUS-3D Test Facility for Two-Phase Measurements inside of Nuclear Reactors

We reproduce two-phase flow conditions in nuclear reactors using our test facility "SIRUIS-3D", and provide high-resolution data measured with the high-energy X-ray CT system.

Test facility for three-dimensional thermal hydraulics in light-water reactors (SIRIUS-3D)

References:

T. Arai, A. Ui, M. Furukawa, R. Okawa, T. Iiyama, S. Ueda, K. Shirakawa and K. Kito, “Void fraction distribution in a rod bundle with part-length rods via high-energy X-ray computed tomography”, Mechanical Engineering Journal, Vol.8, No.4, 2021

A. Ui, T. Ozaki, T. Arai, M. Furuya, R. Okawa, T. Iiyama and S. Ueda, “Optimization of two-phase flow models and estimation of cross-flow in fuel assemblies using data assimilation”, Multiphase Science and Technology, Vol. 34, Issue 2, 2022

Keywords

Two-phase flow

X-ray/CT

Void fraction

Data assimilation

Multi-purpose Steam Testing Facility for Flow Simulation in Plant Piping

Our multi-purpose steam testing facility is capable of precisely controlling the state quantity (e.g., pressure, flow rate, wetness) of high-speed steam flow. With this facility, we conduct multi-purpose tests that simulate the flow conditions of steam system piping in various plants.

Past test results: Vibration phenomenon caused by pressure pulsation at steam piping branches, characteristics of measured values of steam flow meters, and pipe wall thinning phenomenon caused by high-speed droplets in steam flow, etc.

Multipurpose Steam Test Facility

References:

Y. Uchiyama, R. Morita, “Combined Effects of Steam Wetness and Pressure on Characteristics of Acoustic Resonance Amplitude in Closed Side Branch”, J. Pressure Vessel Technol. Feb 2021, 143(1): 011402 (10 pages), 2020

Y. Uchiyama, R. Morita, S. Umezawa, K. Sugita, “Flow rate measurement of wet steam flow by clamp-on ultrasonic flow meter”, Transactions of the JSME, Volume 86 Issue 887 Pages 20-00098, 2020

R. Morita, Y. Uchiyama, “Development of a Wall Thinning Rate Model for Liquid Droplet Impingement Erosion”, Proceedings of the ASME 2012 Pressure Vessels & Piping Division Conference, PVP2012-78443, pp. 1017-1023, 2013

Keywords

- Superheated/wet steam flow control and measurement
- Acoustic resonance, pressure pulsation
- Liquid droplet impingement erosion
- Steam flow meter benchmark test in wet steam
- Wet steam flow visualization
- Continuous supply of negative pressure steam flow

Corrosion Inhibition Technologies for High-Temperature and High-Pressure Plants

We propose corrosion inhibition technologies for actual plants. To make proposals, we evaluate the effects of water chemistry (e.g.,temperature, pH, dissolved oxygen concentration, dissolved hydrogen concentration, chemicals) on the corrosion behavior of structural metals in high-temperature and high-pressure water up to 350°C, and analyze oxide films to clarify the phenomena.

High temperature and high pressure loop system for corrosion evaluation

References:

M. Domae, K. Fujiwara, Y. Ueyama, W. Sugino and K. Hisamune, "Development of Advanced Radioactivity Control Method (ARCOM) in LWR Primary Systems", Proceedings of nuclear plant chemistry conference 2014 Sapporo (NPC 2014), Atomic Energy Society of Japan, 2014

*International Conference on Hydrochemistry of Nuclear Power Plants 2014 Sapporo

Keywords

Water chemistry

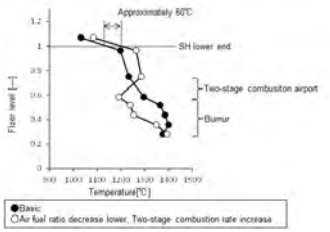
Corrosion

High-temperature and high-pressure water

Structural material

Diagnosis of boiler conditions during operation

We diagnose whether the boiler is operating in a healthy condition by measuring the temperature of combustion gas in the boiler with our original radiation thermometer and analyzing the operation data; we then propose measures to improve operation.



Temperature measurement at an actual power plant and example of gas temperature distribution in the boiler

References:

CRIEPI Research Report M11013 (2019)

CRIEPI Research Report M15008 (2016)

Keywords

Pulverized coal fired boiler	Chemical cleaning
Ash adhesion	Scale
Clinker	Micro sample testing
Furnace gas temperature	Boiler tube
Creep	

Drone Technology: Advancing Safety and Efficiency in Thermal Power Plant Inspections

When inspecting thermal power generation facilities, working at heights involves the installation and removal of scaffolding around the perimeter, the use of elevated vehicles, and rope access, which can be hazardous. In addition, divers who perform underwater inspections of structures often have limited time to work and are at risk in culverted areas. For this reason, the use of drones is effective.

By using drones equipped with real-time kinematic capabilities, we can create 3D models with higher accuracy than conventional drones with less effort.

Precise positioning drone

Keywords

Drone
Laser ranging
Flight control
Close visual inspection
Wall surface

Reference:

CRIEPI Research Report Q19003(2020)

Hydrogen supply chain evaluation

We evaluate the economics and environmental performance of the supply chain, including the conversion process of domestic and foreign green/blue hydrogen to various carriers.

References:

Economic Analysis of Blue Hydrogen in Overseas Production Sites(CRIEPI Research Report/Under Preparation)
CRIEPI Research Report M20002(2021)
CRIEPI Research Report M19003(2020)

Keywords

Hydrogen Energy Carrier	Cost analysis of hydrogen
Methanation	Power to Gas
Synthetic Methane	Renewable energy
Power Generation Cost	Water- and steam- electrolysis
CO_2 Emission Intensity	Output control

Life assessment of hot-gas-path parts in gas turbine

We perform numerical analyses on heat and stress, strength tests, and microstructural observation of hot-gas-path parts in gas turbines to evaluate their service life based on temperature distribution and material damage degradation. These enable us to obtain data to determine the appropriate replacement or repair timing of the parts, thereby reducing maintenance costs.

References:

CRIEPI Annual Research Report 2009 (2009), pp102-103

”Derivation of temperature-estimation equation based on microstructural changes in coatings of in-service blades of gas turbines”, Journal of Engineering for Gas Turbines and Power, Vol. 133, No. 2, 2011, 022101.

”Development of temperature estimation method for a gas turbine transition piece”, Proceedings of ASME Turbo Expo 2016, 2016, GT2016-56182

”Morphological changes in γ’ phase by creep, aging and aging after creep for polycrystalline Nickel-based superalloy”, Proceedings of ASME Turbo Expo 2017, 2017, GT2017-64104

Keywords

Blades	Gas turbines
Cobalt compounds	Nickel compounds
Diffusion	Thermal barrier coatings

Evaluation of environmental resistance of ceramics (CMCs, coating materials)

We conduct exposure tests in high-temperature and high-speed combustion gas flow for ceramics (CMCs and coating materials) that are considered for application to high-temperature components in jet engines and gas turbines. We will evaluate their environmental resistance and soundness.

CRIEPI Burner Rig Test Equipment

Keywords

Ceramics	Reynolds number
Combustion gases	Temperature
Flow (Dynamics)	Water vapor
Silicon nitride ceramics	High temperature
Pressure	Weight (Mass)
Silicon	Etching
Gas flow	Grain boundaries
Gas turbines	Hot pressing
Mass transfer	Water
Oxygen	

References:

"Recession Rate Prediction for Ceramic Materials in Combustion Gas Flow", Proceedings of ASME Turbo Expo 2003, 2003, GT2003-38886

"Exposure Test Results of Lu2Si2O7 in Combustion Gas Flow at High Temperature and High Speed", Proceedings of ASME Turbo Expo 2004, 2004, GT2004-54277

Evaluating the Grindability and Combustibility of Solid Fuels for Pulverized Coal-Fired Power Plants

We evaluate the grindability and combustibility of solid fuels used in pulverized coal-fired power plants, such as coal and biomass, using coal combustion test facilities.

Through this evaluation, we can assess the applicability of various fuels to pulverized coal-fired power plants and identify issues before using them.

Coal combustion test facility

Reference:

CRIEPI Research Report W03025(2014)

Keywords

Coal

Thermal power station

Pulverized coal combustion

Furnace

Flue gas treatment equipment

Insulation Deterioration Evaluation of XLPE Cable

Understanding the dielectric strength of aged XLPE cables is very important for cost-effective underground electric power transmission, which is often applied in urban areas. This facility consists of the pre-breakdown discharge detection testing system to extract the water tree which develops in the electrical insulation layer of the XLPE cable and causes the degradation of its electrical insulation capability. The obtained results are indispensable for management of the aged XLPE cables.

Highly Aged XLPE Power Cable Deterioration Test Facility

Keywords

- Decommissioned XLPE cable
- Electrical insulation capability and deterioration
- Partial discharge
- Water-tree degradation

Reference:

T, Takahashi, "Water Trees as a Dominant Deterioration Cause of 60 kV Class Dry Cured XLPE Cables" (CEDIP 2019)

Performance Evaluation of Lithium-ion Batteries

We evaluate factors contributing to performance degradation of Lithium-ion batteries. In details, we perform disassembly of the degraded batteries, material evaluation of the battery components, characteristics evaluation of the battery electrodes by reassembling cells with the electrodes, and nondestructive evaluation such as micro-heat measurement and precise current measurement. Moreover, we can perform lifetime estimation by accelerating the performance degradation in low/high temperature environment and execution of charging/ discharging cycles.

Charge-discharge performance test device

Reference:

CRIEPI Annual Report FY2017 (2018), pp.58-59

Keywords

Lithium-ion Battery

Life Evaluation

Evaluation of High-Voltage, High-Current Power Semiconductor Devices for Power System Control

We evaluate the current-voltage characteristics and switching characteristics of high-voltage, high-current power semiconductor devices (thyristors, Gate Turn-Off (GTO) thyristors, diodes) for power system control.

Evaluation equipment of current-voltage and switching characteristics of power semiconductor devices

Keywords

Power semiconductor devices

Thyristors

GTO thyristors

Diodes

High-voltage

Corrent-voltage

Swtiching characteristics

› Licensing software and related services

The Smart Grid Simulator

XTAP (eXpandable Transient Analysis Program)

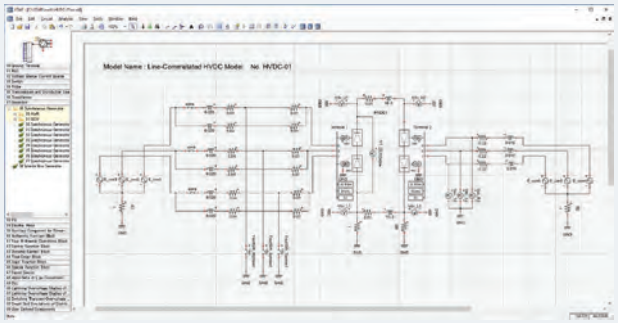
Overcoming Your Challenges

To perform simulations of power systems, including power electronics circuits.

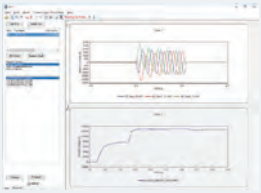
Why CRIEPI?

A computer program developed by CRIEPI for the waveform-level or Electromagnetic transient (EMT) simulations of power systems is licensable. Lectures and training to use will be delivered upon request.

Schematic Editor



Waveform Plotting Tool



Line/Cable Constants Calculation Tool

Our Tools

XTAP (eXpandable Transient Analysis Program)

CRIEPI's Clients/Users

Power utility companies in Japan use XTAP as the standard simulator. Major manufacturers, universities, and research institutes are our clients/users.

References:

- CRIEPI Research Report H15004 (2015)
- CRIEPI Research Report H13010 (2013)
- www.xtap.org

SOFTWARE SOLUTIONS OF YOUR OWN…PROVIDED BY US

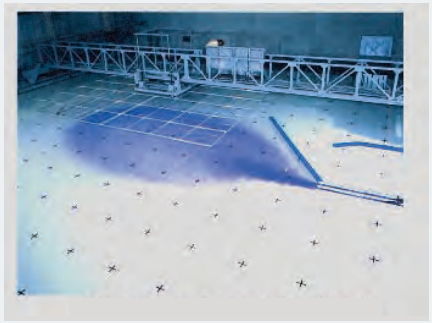
> Licensing software and related services

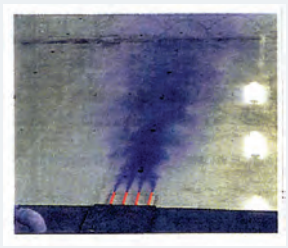
Prediction of buoyant effluent dispersion in coastal area

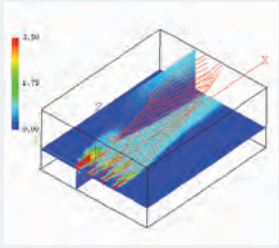
Thermal and nuclear power plants, LNG facilities, seawater desalination plants, sewage treatment plants, and other facilities located in coastal areas discharge wastewater that has a different temperature and salinity from the ambient fluid, and there is concern about the impact on the coastal environment.

We can predict the diffusion range of wastewater discharged into coastal areas through hydraulic model experiments and 3D numerical models.

The numerical model uses a turbulence model to calculate the 3D diffusion process of density jets from underwater outlets .The model can simultaneously calculate water intake and discharge as well as evaluate the recirculation of wastewater, and can evaluate the recirculation of wastewater.







Experiment on the diffusion of discharged cooling water

Past Experimental Results

Prediction of thermal effluent dispersion as part of a feasibility study for an overseas power plant construction project.

Environment

Keywords

- Negative buoyant jet
- Density current
- k- ε model
- LNG plant

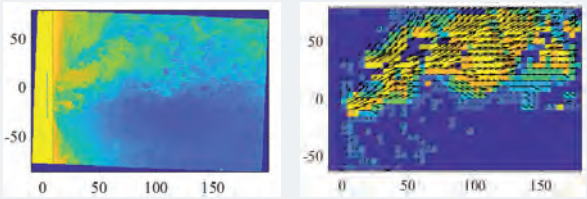
Reference:

CRIEPI Annual Report FY2015(2016), pp.52-53
Niida Y., Nakashiki N., Sakai S., Tsubono T., A THREE-DIMENSIONAL MODEL OF DISCHARGED COLD WATER JET IN COASTAL AREA, EMECS11-Sea Coasts XXVI Joint Conference, 2016

Image measurement of water surface velocity and temperature by using unmanned aerial vehicle (UAV)

By applying multiple image processing method to images taken by UAVs (drones), we obtain water temperature and velocity distributions.

We monitor effluent dispersion from power plants, factories, and sewage treatment plants located in coastal areas, as well as backwaters flow velocities downstream of bridges and offshore wind farm foundations and piles. In this way, we obtain measurement data with a high spatio-temporal resolution not available with conventional methods.



Wastewater observation using UAV

Environment

Keywords

- UAV
- Jets
- Thermography
- Imaging measurement
- Coastal environment

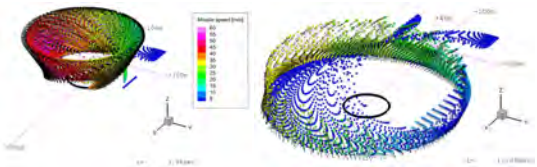
Reference:

Y. Niida, T. Tsubono, K. Nakaya, S. Sakai, N. Nakashiki, T. Ishii, "MEASUREMENT OF THE BUOYANT JET AT SEA SURFACE BY USING THERMOGRAPHY MOUNTED ON UAV", Journal of Japan Society of Civil Engineers, Ser. B2 (Coastal Engineering), Volume 74 Issue 2, Pages I_1423-I_1428, 2018

TONBOS

(Software to numerically simulate lift off and flight of potential missiles driven by a tornado)

TONBOS is a numerical analysis code that can compute the lifting and flying behavior of unconstrained objects (potential missiles) on the ground driven by the wind force of tornadoes. Either the Rankine vortex or the Fujita model (DBT-77) can be selected as the wind field for tornadoes; in the Fujita model, objects on the ground are modeled in consideration of li˜ forces due to ground effects. TONBOS can be run with the Windows command prompt. An Excel-based version is also available for greater efficiency in data input and output via the graphical user interface (GUI).



Simulation results by TONBOS

Keywords

Tornado	Fujita model
Air-borne missile	Numerical simulation
Lift off and flight of objects	

Nuclear Power Generation

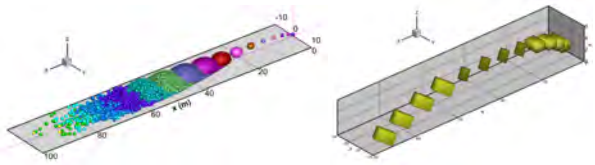
References:

CRIEPI Research Report N14002(2014)
Y. Eguchi, K.D. Hope, B. Cassenti, V. Moreno, J. Bebrin and E. Li, Benchmark Computation of Tornado-borne Missile Flight using Fujita Wind-field Model, Annual Meeting of the Japanese Society of Fluid Mechanics 2016.

TONBOS-pro

(Probabilistic high wind-borne missile analysis code)

TONBOS-pro is an analysis code that can evaluate the stochastic dispersion characteristics of flying objects that are lifted off and scattered by typhoons and tornadoes. Considering the randomly changing initial and aerial orientation of flying objects, the software models the aerodynamic forces acting on wind-borne objects based on cross-flow theory. The software also considers the lift forces acting on flying objects placed in contact with the ground, allowing us to evaluate the scattering and falling behavior of potential missiles that are initially placed on the ground or in the air under the conditions of the surface-boundary-layer wind field and tornado wind field.



Simulation results by TONBOS-pro

Keywords

High wind	Tornado-borne missile
Probabilistic assessment	Random rotation
Typhoon-borne missile	

Nuclear Power Generation

Reference:

CRIEPI Research Report O20004(2021)

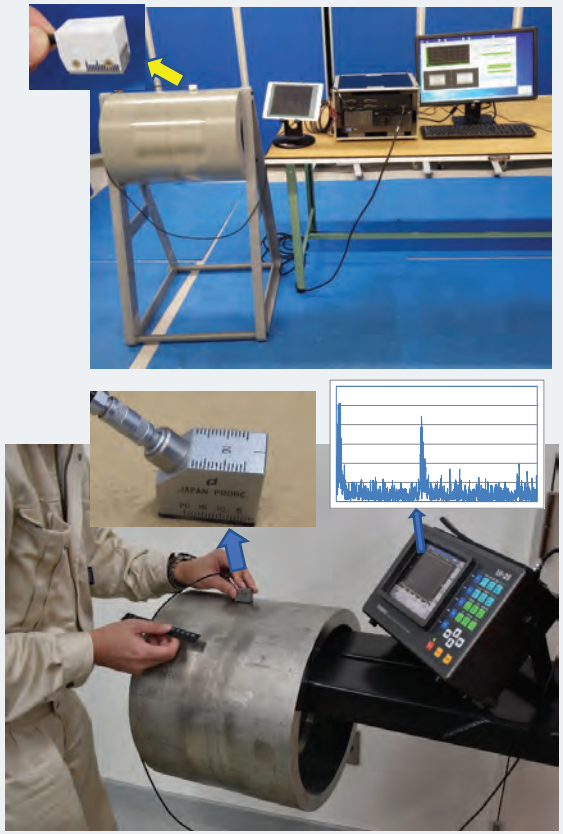
Licensing software and related services

Virtual UT system

Ultrasonic testing (UT) to detect defects in steel welds is highly dependent on the test engineers' skill. In particular, detecting defects on the inner surface of pipe welds is difficult and requires training for the test engineers. Training requires a large number of flawed specimens, which are very expensive.

Our Virtual UT System simulates UT work on actual piping, which enables the training and evaluating of test technicians without the use of actual test specimens or equipment.

The Virtual UT System can be provided as software, as a system, or as a basic training set.



Virtul UT (Ultrasonic Testing) system

Nuclear Power Generation

Keywords

Ultrasonic Testing (UT)	Nuclear Power Plant
Inservice Inspection (ISI)	Virtual System
Examination Personnel	Human Factor
PD Qualification System	

References:

- H. Shohji, K. Hide, "Development of Virtual Ultrasonic Testing System," Proceedings of 11th International Conference on NDE in Relation to Structural Integrity for Nuclear and Pressurized Components,WE_1_A-4 (2015).
- H. Shohji, S. Lin and K. Hide, "Development of a Virtual Ultrasonic Testing System", E-Journal of Advanced Maintenance (Web) (EJAM (Web)), Vol.10 Issue 2, Japan Society of Maintenology, 2018
- CRIEPI Annual Report FY2015 (2016), pp.26-27
- CRIEPI Research Report Q14007 (2015)
- CRIEPI Research Report Q16012 (2017)
- CRIEPI Research Report Q19007 (2020)
- CRIEPI Research Report EX21001 (2022)

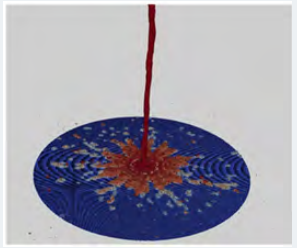
PHALSER

PHysics-based particle AnaLyzer for SEveRe accident

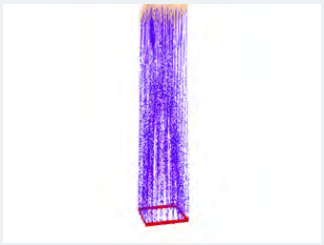
PHALSER is a particle method-based simulation code that can simulate complex phenomena including melting, solidification, and rearrangement of materials based on physical laws by implementing models of various physical phenomena.

PHALSER incorporates each physical model as a module, and by selecting the appropriate module, it is possible to analyze a wide variety of phenomena (e.g.,tsunami inundation behavior, spray dissipation behavior, fuel melting and relocation during a nuclear reactor accident).

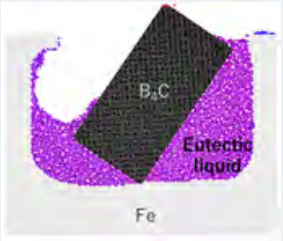
Achievements to date: Numerous analyses have been conducted as part of research commissioned by the government and other organizations.



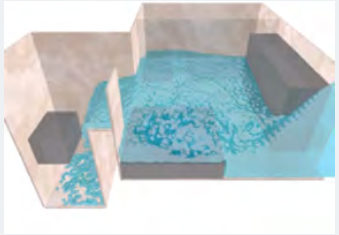
Spreading and solidification of molten material



Spray droplets dissipation



Eutectic liquefaction



Tsunami flooding inside reactor building

Simulation examples of PHALSER

Nuclear Power Generation

Keywords

- Particle method
- Melting and solidification of materials
- Fluid dynamics
- Severe accident

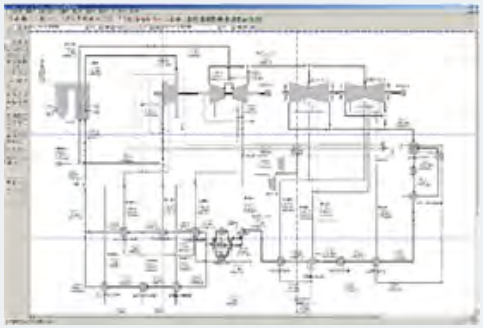
Reference:

K. Inagaki, "Development of multiphysics particle method simulation code PHALSER and its application to various phenomena" Journal of Nuclear Science and Technology 58, 8 (2021) 857-871+I23

Licensing software and related services

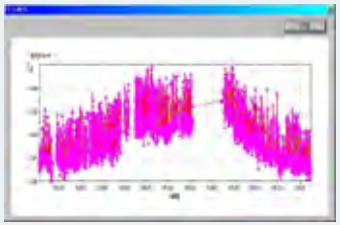
EnergyWin

EnergyWin is a thermal efficiency analysis application for power generation systems. It can be deployed not only with conventional thermal power systems but also advanced/innovative power systems like Integrated Coal Gasification Combined Cycle (IGCC), Fuel Cell, and so on. EnergyWin enables users to identify degradation factors in thermal efficiency and analyze the system to support the development of new power generation.



Heat and Mass Balance

Calculation result



EnergyWin

Thermal Power Generation

Keywords

- Thermal efficiency
- Thermal power plant
- Thermal efficienc y management
- Heat and mass balance analysis
- Thermal efficiency analysis program

Reference:

EnergyWin
https://criepi.denken.or.jp/en/energy/research/research11.html

MapsGT (Maintenance Planning Optimization Support System for Gas Turbine Hot-Gas-Path Parts)

MapsGT is the management support software to simulate usage records to support operation planning of gas turbine hot-gas-path parts. Users can simply provide operational information inputs; the vast number of usage records for hot-gas-path parts can be simulated. When building the operating plan, the remaining service life of hot-gas-path parts is calculated according to simulated usage records and scheduled operating hours, MapsGT predicts the durability of parts for the next planned inspection. The cost calculation of operating plan is calculated, users can also evaluate the cost variation while changing the inspection plan.

Parts rotation schedule

Parts information (e.g. Liner)

MapsGT

Thermal Power Generation

Keywords

- Thermal power generation
- Planning optimization
- Gas turbine
- Maintenance planning
- Hot gas path part
- Cost estimate
- Cost management

References:

CRIEPI Research Report W02014 (2002)
CRIEPI Research Report M06003 (2006)
CRIEPI Research Report M07008 (2007)

Licensing software and related services

CRIEPI Coals

CRIEPI Coals is the software for visualizing the cost and the impact on the machine performance and emissions related to the operation and the coal types in pulverized coal fired power plants. Fuel costs, ash disposal cost, ammonia cost, and other cost are evaluated, CRIEPI Coals visualizes the economic performance, fuel properties, and operating conditions (Co-firing rate, O^2 concentration at the economizer, etc.), and recommends the effective approaches for low grade coal utilization and operation improvement.

Application image of CRIEPI Coals

Thermal Power Generation

Keywords

- Pulverized coal power plant
- Coal
- Operation
- Evaluation
- Software

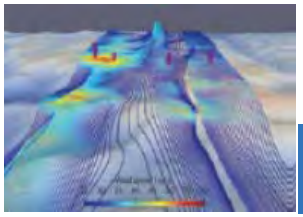
Reference:

CRIEPI Annual Report FY2018(2019) , pp.28-29

NuWiCC

(Numerical wind simulation code of CRIEPI)

NuWiCC is a numerical fluid dynamics simulation code developed for the wind-resistant design of transmission towers, selection of suitable sites for wind turbines, and evaluation of wind power generation output. It can estimate the mean and fluctuating amounts of 3D wind flow affected by topography and land use.



Local wind simulation result

Keywords

Local wind	Transmission tower
Mountainous area	Wind power generation
Wind-resistant design	

Electric Power Transmission and Distribution

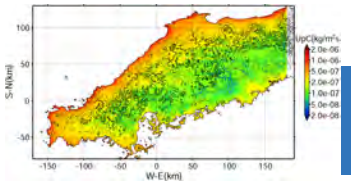
References:

CRIEPI Research Report N08047(2009)

NuWiCC-ST

(Numerical wind simulation code of CRIEPI - Sea-salt particle transport edition)

NuWiCC-ST is a numerical simulation code developed for estimating the corrosion of power transmission and distribution facilities. The software can estimate the sea salt flux affected by topography and land use based on numerical fluid dynamics simulation. Moreover, estimation of wide-area distribution of long-term cumulative sea salt mass is possible.



Yearly mean distribution maps of airborne sea salt at 40 m above ground height

Keywords

Sea salt particle	Statistical method
Local wind	Power transmission facility
Computational fluid dynamics	

Electric Power Transmission and Distribution

References:

Suto, H. et al. (2017). Computational fluid dynamics simulation and statistical procedure for estimating wide-area distributions of airborne sea salt considering local ground conditions. Structure and Infrastructure Engineering, 13(19), 1359–1371.
Suto, H. et al. (2021) Prediction of surf-zone and open-ocean airborne sea-salt spatial distribution via computational fluid dynamics and statistical method, Corrosion Engineering, Science and Technology, 56:4, 392-400.

Licensing patents and related services

A METHOD TO

Ensure Sealing Performance of Canisters

inside Concrete Casks

Overcoming Your Challenges

To check sealing performance of canisters during storage

Why CRIEPI?

Our method is based on using temperature changes on the canister surface to detect helium leaks from the canister due to stress corrosion cracking (SCC). It is a method for estimating the leak amount ratio to the heat rates of the canister by measuring the increase in temperature difference between the bottom and the lid of the canister. Compared to using the metal cask, in which a pressure gauge is installed, this method is more economical and provides ease of maintenance for a sensor, as a thermo-sensor is installed only on the exterior surface of the canister inside the concrete cask. In addition, there is no need to drill a hole for installing the thermo-sensor in the canister; therefore, no more creation of leakage risks. We also have a method applicable to horizontal silo storage systems.

Our Equipment

1 / 4.5 scale cask model

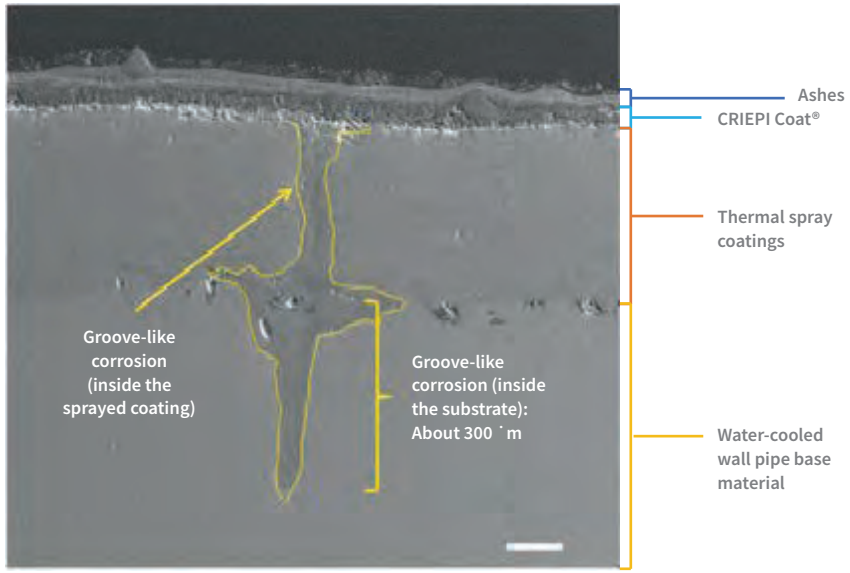
CRIEPI's Contributions

This leak detection method with high sensitivity contributes to the safety and reliability of the concrete casks. In addition, if the requirements for SCC inspections are eliminated or mitigated, our method will significantly reduce inspection expenses.

References:

- CRIEPI Research Report N04031 (2004)
- CRIEPI Research Report N15006 (2015)
- CRIEPI Research Report N18007 (2019)
- CRIEPI Research Report N17007 (2018)
- CRIEPI Research Report N17013 (2018)
- Takeda et al., Nuclear Engineering and Design [Vol.238](2008)
- Takeda, Nuclear Engineering and Design [Vol.352](2019), [Vol.362](2020)

More of our other interesting technologies…



CRIEPI Coat®

This coating prevents thinning and cracking of the sprayed coating and sulfide penetration on walls. For boilers in thermal power plants, this coating can prevent sulfide corrosion and high-temperature oxidation within the temperature range of 300°C to 700°C.

This coating is effective to prevent concurrent corrosion where the groove corrosion occurs, and the progress of the groove corrosion can be suppressed at the same time. In addition, this coating can suppress the thinning and oxidation on walls, and help prolong the lifetime of sprayed coating.

Thermal Power Generation

Keywords

- Boiler heat transfer surface
- Superheater tubes
- Reheater tubes
- Stub tubes
- High temperature oxidation
- Corrosion protection

References:

- CRIEPI Research Report M04 (2015)
- CRIEPI Research Report M16001 (2017)
- CRIEPI Research Report M18004 (2019)
- CRIEPI Research Report M19001 (2020)
- Development of SiO2/TiO2/Al2O3-based /TiO2 coating for preventing sulfide corrosion in thermal power plant boilers, Applied Thermal Engineering, 153 (2019) pp.242-249

> Testing and qualification

High Power Short-Circuit Test

High Power Testing (Short-Circuit Testing)

Overcoming Your Challenges

To perform short-circuit testing

Why CRIEPI?

We use various equipment of short-circuit generation (15 kV, 2,500 MVA, current up to 150 kA) to perform high power short-circuit testing. We also perform accreditation tests, such as making and breaking performance tests for switchgears, general tests, such as arc tests, short time current test, and synthetic test. Disaster prevention measures test of OF cables, arc fault fire verification test of electrical cabinets and bus duct in nuclear power plants.

COPY

Testing Laboratory

Accreditation Certificate

Accreditation No.RTL01000

Central Research Institute of Electric Power Industry
High Power Testing Laboratory,
Electric Power Engineering Research Laboratory

2-6-1, Nagasaka, Yokosuka-shi, Kanagawa, 240-0196 Japan

meets the following criteria. On the basis of this, Japan Accreditation Board (JAB) grants accreditation to the said testing laboratory.

Applicable accreditation criteria	:	JIS Q 17025:2005 (ISO/IEC 17025:2005)
Scope of accreditation	:	**Electrical testing** (As described in the appendix)
Premises covered by accreditation	:	As described in the appendix
Expiry date of accreditation	:	December 31, 2017

This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system.
The management system requirements in ISO/IEC 17025:2005 meet the principles of ISO 9001:2008 and are aligned with its pertinent requirements.

Revised (9)	August 22, 2016
Renewed (3)	November 7, 2013
Initial accreditation	December 25, 2001

T. Oda, Chairman
Laboratory Accreditation Committee

Y. Iizuka, President
Japan Accreditation Board

Issue No. : RTL01000-20160822

Our Equipment

High Power Short-Circuit Testing Facility

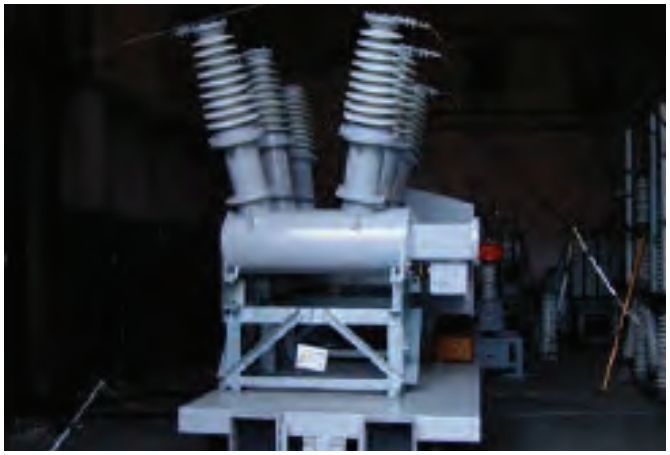
CRIEPI's Journey

Since the High Voltage Power Laboratory, now part of CRIEPI, installed high power test facilities in 1963, CRIEPI has conducted research and tests on the short-circuit performance of power equipment and materials. Later the High Power Testing Laboratory was established in April 2001 and granted by the Japanese Accreditation Board for Conformity Assessment (JAB) in compliance with ISO/IEX17025. This Laboratory meets international standards and is involved in various test activities that include publishing test reports and issuing certificates.

References:

- M. Iwata et al., "Calculation of Molten and Broken Characteristics of ACSR Strands Due to AC Fault Arcs", IEEE Transactions on Power Delivery, Vol.34, No.2, 2019
- High Power Testing Laboratory https://criepi.denken.or.jp/en/hptl/

Accreditation tests



Short-circuit tests for VCBs

Making and breaking tests for switchgear

Short-circuit tests and out-of-phase making and breaking tests for circuit breakers (up to rated voltage of 36 kV and rated short-circuit breaking current of 25 kA)

Other tests

- Short-time withstand current and peak withstand current tests for circuit breakers, disconnectors and earthing switches, load break switches, metal-enclosed switchgear, and gas-insulated switchgear (current up to 150 kA, duration up to 1 s / current up to 60 kA, duration up to 2 s)
- Short-circuit tests for power transformers, surge arresters, and power fuses (test capacity depends on item tested)

General tests

High-power arc tests for polymer insulators

The High Power Testing Laboratory is a member of JSTC (Japan Short-Circuit Testing Committee), which is a member of the international Short-Circuit Testing Liaison (STL)

High-power arc tests (AC/DC)

- Insulators
- Insulator assemblies
- Switchgear
- Cables
- Cable assemblies
- Transformers

Short-time current tests (AC/DC)

- Cables
- Transformers
- Other equipment

Synthetic and other tests

- Synthetic tests for circuit breakers
- Duty tests for surge arresters

High power short-circuit test facilities

- Short-circuit generator
- High voltage short-circuit transformer
- Ultra-high current transformer
- Extra-high voltage short-circuit transformer
- Synthetic test facilities
- DC short-circuit test facilities
- Indoor test cell with soundproofing
- Automatic control system and computer measurement system for short-circuit tests

HEAF (Arc internal Test on the electrical equipment
*(Electrical Cabinet, Bus Duct etc.)**)***

High-Energy Arcing Fault (HEAF) events in electrical equipment (such as electric cabinets, bus ducts, etc.) are recognized as one of the risks that impact the safety of power plants, such as thermal and nuclear power plants. Finding solutions for HEAF is a critical issue worldwide. Only CRIEPI has conducted research and development on HEAF fires and succeeded in standardizing the testing methods and established the HEAF fire prevention method.

References:

- K. Shirai et al., “Proposal of an Evaluation Method for Prevention of High Energy Arcing Fault (HEAF) Induced Fires at Low and High Voltage Electrical Cabinets”, 16th Int. Post-Conf. Seminar on Fire Safety in Nuclear Power Plants and Installations, 2019.10.
- CRIEPI Research Report O18002(2018)
- CRIEPI Research Report O20009(2021)

Unlock your potential …with our cutting-edge training sessions

Training & Seminar

Series of technologies related to the syngas treatment for the gasification based energy conversion systems

Overcoming Your Challenges

The syngas treatment process course provides the extended view and practical information on the dry syngas purification technology for various energy conversion systems based on coal gasification. It delivers promising development status of the technology from sorbent development to the process development including plant construction.

CRIEPI' s Contribution

Our R&D activities since 1980s completed development of core technologies of dry syngas purification, which includes methodologies for impurity measurement, sorbents development, and evaluation of process performance. They encompass information to deliver the technologies to a practical application to actual coal-based energy conversion systems.

Attainments

Reaction mechanism analysis with in situ XRD for determining sorbent behavior under pressurized and high temperature syngas condition

Why CRIEPI?

We can provide you with:

-Customized dry gas purification process application strategies

-Analytical techniques for various impurities related to gasification and gas purification

-Rational methods for the development of pyrochemical scavengers for various impurities

-Engineering evaluation methods for the design and integration of gas purification processes

-Engineering evaluation methods for scale-up of dry gas purification systems

Reference:

- Makoto Kobayashi, Dry Syngas Purification Processes for Coal Gasification Systems, ISBN: 978-0-12-818866-8, PUB DATE: November 2020

Joint Research

Utilization of thermal power plants to accelerate an integration of intermittent renewable energy sources for Joint Crediting Mechanism (JCM)

We are engaged in research to promote both the introduction of renewable energy and the stable operation of the power system by incorporating the surplus power generated by the increase in renewable energy into the load regulation operation of thermal power generation facilities.

We invite you to join us in evaluating methods to utilize existing thermal power generation to promote the introduction of renewable energy. Collaboration work with us to promote electricity decarbonization, power system stability maintenance, and sustainable economic development in Japan and elsewhere, and to enable the use of JCM together with the target countries.

Keywords

Coal-fired power plant	Secondary control reserve
Operational flexibility	Demand–supply balance
Load frequency control	Energy loss

Thermal Power Generation

Reference:

"Methodology to evaluate contribution of thermal power plant flexibility to power system stability when increasing share of renewable energies: Classification and additional fuel cost of flexible operation" Fuel 292 (2021) 12035

Dynamic analysis tool and technique for energy systems

We have developed a dynamic analysis tool for various energy systems (e.g., steam power generation, combined cycle, various new power generation systems, hot water heat pumps, etc.) that can perform operational simulations for various system configurations and operating conditions.

By utilizing this analysis tool, it is possible to construct a simulator that can quickly and quantitatively predict the operational characteristics of the target system. Would you like to conduct a joint project with us to search for a system configuration with excellent operability and evaluate operational control measures?

Keywords

Modelica	Dynamic analysis and technique
Energy system	Steam power generation
Heat pump	Combined cycle

Thermal Power Generation

References:

- Approach to Dynamic Analysis Based on Modelica for Thermal Power Plants, Modelica Users' Conference 2019 Japan.
- Dynamic Simulation of Steam Bottoming System in a Combined, IGTC2019 Cycle Power Plant with Modelica
- Development of a General-purpose Analytical Tool for Evaluating Dynamic Characteristics of Thermal Energy Systems, Modelica Conference 2019

Joint Research

Mechanisms of radiation-induced carcinogenesis at low dose-rate

We invite you to conduct joint research using our world-class Microbeam X-ray irradiation system, Long-term low dose rate irradiation facility, and other research equipment, as well as our own genetically engineered mice, cultured cells, and archived mouse tissue specimens.

Collaborate with us to produce original research that meets international standards and share the results with the world.

Keywords

Low dose rate
Low dose
X-ray microbeam
Stem cell competition
Circulatory disease

Long-term low dose rate irradiation facility

Microbean X-ray iiradiation system

Nuclear Power Generation

References:

- Fujimichi et al., Radiat Prot Dosimetry. 198(13-15):1115-1119 (2022)
- Fujimichi et al., J Radiat Res. 63(2):166-173 (2022)
- Fujimichi et al., Sci Rep. 9(1):20297 (2019)
- Hamada et al., Cancers (Basel). 14(14):3319 (2022)
- Hamada et al., Cancers (Basel). 13(21):5344 (2021)
- Hamada et al., Cancers (Basel). 12(10):3030 (2020)
- Otsuka and Tomita, Sci Rep. 8(1):17309 (2018)
- Otsuka et al., J Radiat Res. 59(suppl_2):ii18-ii22 (2018)
- Otsuka and Suzuki, Radiat Res. 186(3):302-14 (2016)
- Otsuka and Iwasaki, J Radiat Res. 56(4):615-22 (2015)
- Tomita et al., Radiat. Res. 179(2):200-207 (2013)
- Tomita et al., J Radiat Res. 53(3):482-488 (2012)
- URL of the OECD/NEA "Global Register of Low-Dose Research Projects" database: https://www.oecd-nea.org/ldr/

Research Reports

GUIDE FOR

Qualitative Analysis in The Human Reliability Analysis (HRA) with Emphasis on Narratives

(FY 2020 Edition)

To improve HRA in probabilistic risk assessment (PRA), which deals quantitatively with the evaluation of human response failures, we have developed a qualitative analysis method to collect and aggregate plant- and scenario-specific situations that affect humans who perform accidental death response tasks as "narrative knowledge." In addition, we have developed an analytical model and analytical know-how for HRA of tasks under severe conditions.

As examples of evaluations using this method, we have presented feed-and-bleed operations and the opening of watertight doors when evacuating buildings during a tsunami.

An English version of the guide is provided as an appendix on pages 71-152 of the Japanese version of the guide.

The guide (CRIEPI Research Report: O20003) is available at:

CLICK HERE FOR MORE

Keywords

- The Human Reliability Analysis (HRA)
- Qualitative Analysis
- Narratives
- Human Failure Event(HFE)
- Accident Scenario Context
- Probabilistic Risk Assessment (PRA)

Reference:

CRIEPI Research Report O20003(2021)
https://criepi.denken.or.jp/hokokusho/pb/reportDetail?reportNoUkCode=O20003