ABS Group

APAC SERVICES

EXTREME LOADS AND STRUCTURAL RISK

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ABOUT ABS GROUP

Operational Risk and Compliance Solutions

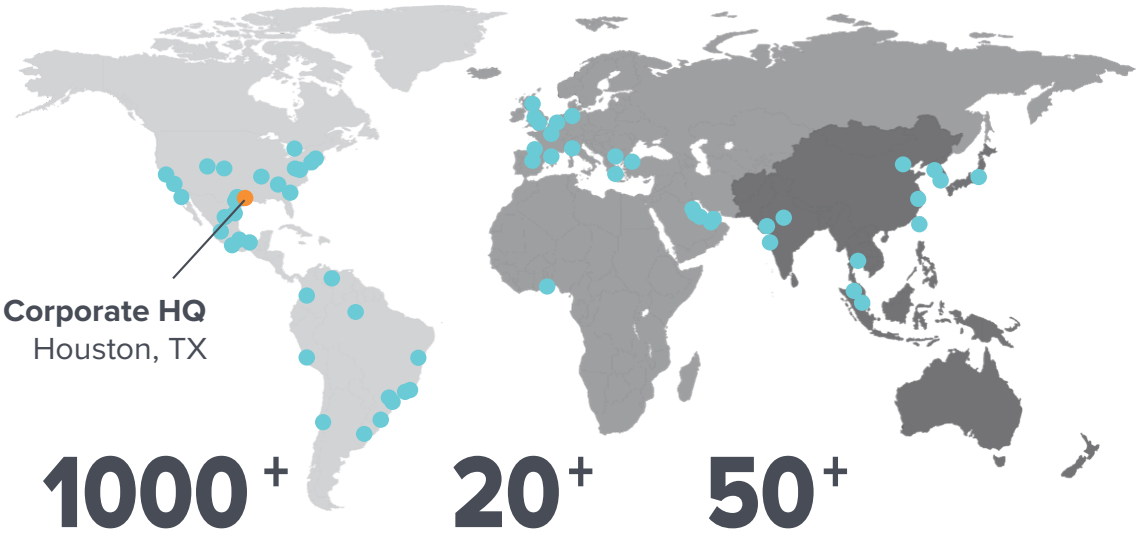
For over 50 years, ABS Group has been serving a diverse set of global customers in high hazard industrial markets.

We deliver practical solutions grounded in risk management principles, deep domain expertise and rigorous, objective analysis to improve the safety, security, sustainability and performance of critical operations. We support the entire energy value chain offering solutions that support the asset lifecycle.

Why ABS Group

Our engineers and consultants have experience and proven methods for analyzing and managing a wide range of known and emerging risks to our clients' operations, including major accidents, equipment failures, natural disasters, terrorist attacks and cyber threats. We are uniquely positioned to meet our clients' needs through our long-standing work with governments, regulators and standards organizations, ultimately bringing industry-wide perspectives to shape regulation. Our technical experts implement practical solutions designed around each client's unique operational and regulatory environment that meet the complex challenges of today while positioning them for the uncertainty of tomorrow.

Global Reach



1000+ experts

20+ countries

50+ years

SECURITY-BY-DESIGN

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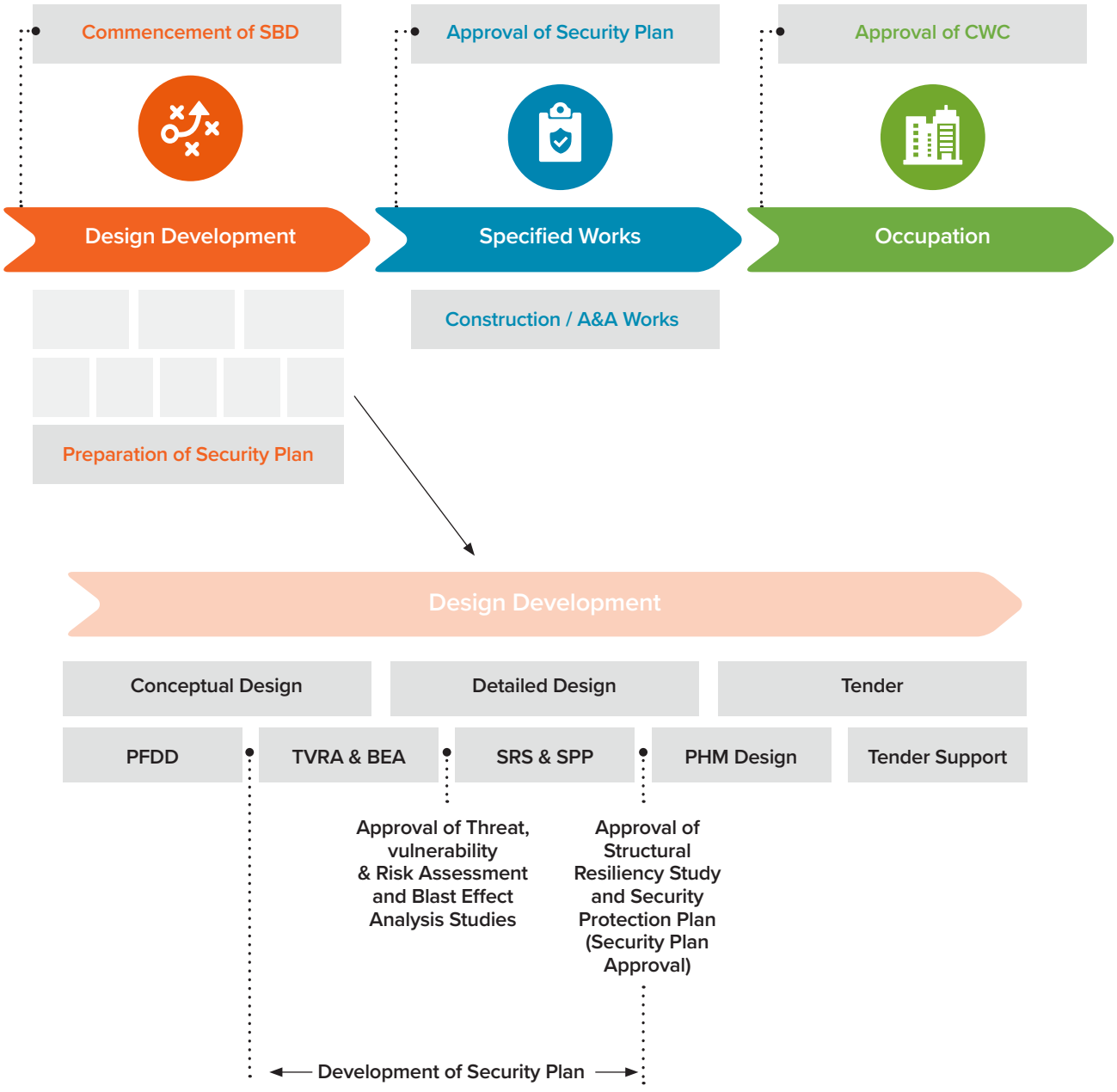
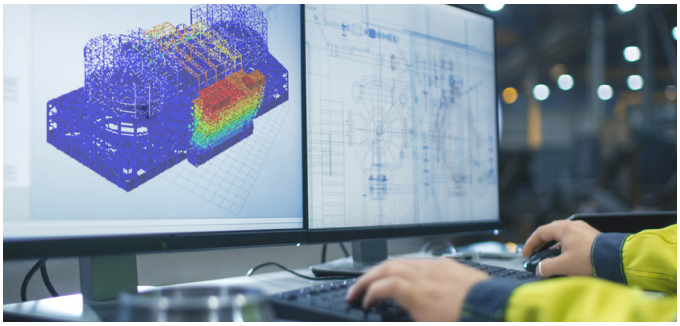
Security-By-Design (SBD) is a process where security is considered upfront in the development process, with security features integrated into the building design.

Under the Infrastructure Protection Act, the SBD review process requires a security and/or blast consultant to be brought on board by the Responsible Persons (RP) to prepare the security plan, which identifies the risks and vulnerabilities of a building and develops the necessary security measures to mitigate the risks. The security and/or blast consultant must be approved by the Commissioner of Infrastructure Protection as a Competent Person (CP) for the project.

ABS Group's Extreme Loads and Structural Risk (ELSR) division contains three Competent Persons (Blast) approved by the Commissioner of Infrastructure Protection, who have participated in over 50 SBD projects in Singapore since 2006. Our experts are widely recognized throughout the industry for their contributions to the field of blast effects analysis and design of protective hardening measures.





Services to Support You

- Threat, Vulnerability and Risk Assessment
- Blast Effect Analysis
- Structural Resiliency Study
- Security Protection Plan

Your Competent Persons for Blast

Nelson Duran
CP (Blast)

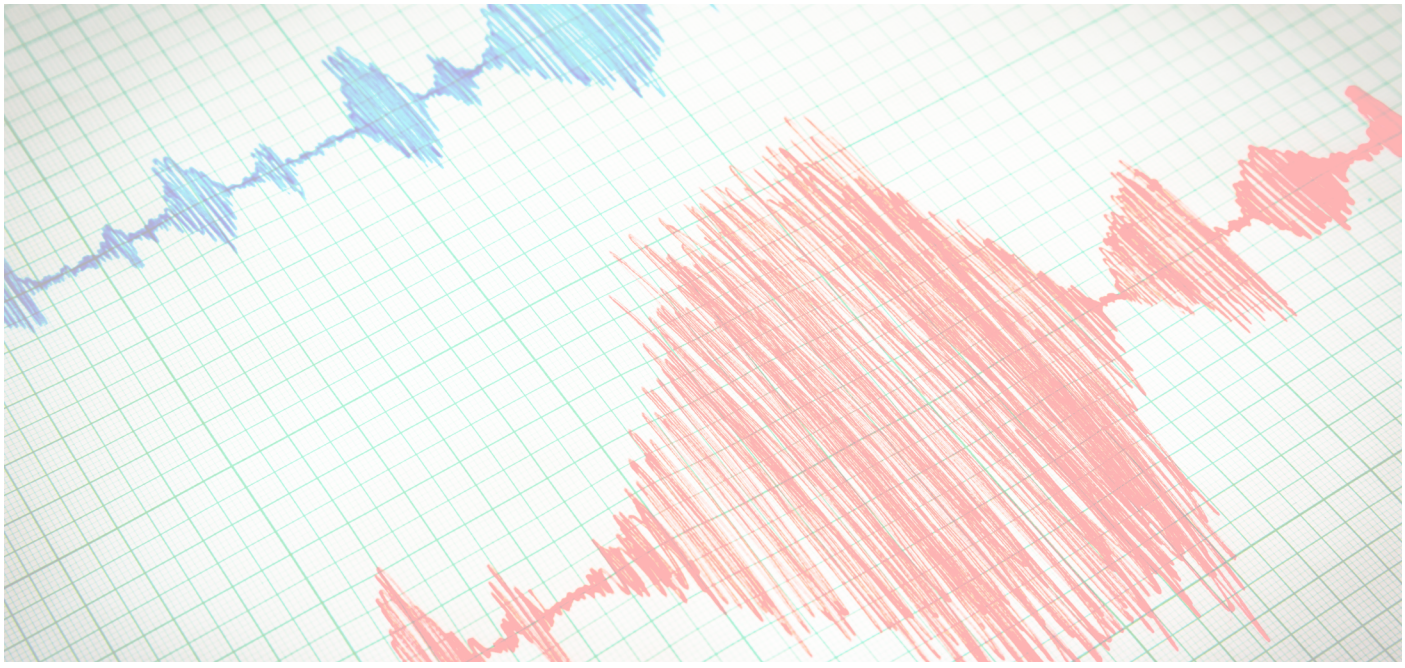
Nelson has over 18 years of experience in the design and analysis of structures subjected to high energetic events, impulsive loaded impacts and blast loads in 65+ Security by Design projects on government, commercial and industrial facilities in Singapore.

Mindy Loo
PhD, CP (Blast)

Mindy has experience as an external and in-house consultant, leading projects related to security and blast for government and private sector clients.

Darrell Barker
PE, CP (Blast)

Darrell has over 30 years of experience with blast-resistant design and construction, conducting terrorist threat assessments of more than 200 government and commercial buildings around the world.



BLAST MITIGATION ANALYSIS AND DESIGN

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ABS Group is a leading independent global risk management firm. We provide clients with practical engineering and technology-based solutions to assist in managing operational, security and catastrophic risks.

We provide solutions to problems utilizing advanced modeling and analysis tools plus performing research and development programs. ABS Group has a worldwide network of offices providing a wide range of specialized engineering and risk management services. Included is the Extreme Loads and Structural Risk division with offices throughout the United States, UK and Singapore specializing in structural assesment for extreme events such as blast, seismic and wind storms. The Explosion Hazards Group, located in San Antonio, Texas, offers services related to blast hazards and associated structural design.

Advanced Structural Analysis

- Blast Analysis
- Seismic Analysis
- Extreme wind and Flood
- Vibration Studies
- Terrorist Threat Assessment
- Anti-Terrorism and Force Protection (AT/FP)

Design and Construction of Building Structural system

- New Design and Building Upgrades
- Perimeter Vehicle Barrier Systems
- Shielding, Barricades and Blast Attenuation System
- Structural Hardening
- Window and Door Upgrades

Physical security

- Blast Shield Walls
- Vehicle Barriers
- Intruder Delay Barriers
- Asset Protection

Modeling Capability

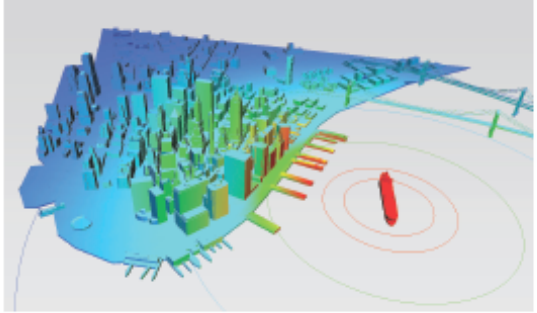
- Explicit Dynamic FEA (ABAQUS, ANSYS, LS-DYNA)
- General FEA (SAP)
- CFD (CEBAM, FLACS, FLUENT)
- Blast (SBEDS, SBEDS-W, C CONWEP, BLASTX, SHOCK/ FRANG)

Technical Capabilities

- Advanced Structural Analysis
- Hydocode and Computational Fluid Dynamics (CFD)
- Explosion Hazard and Blast Resistant Design
- Seismic Design
- Terrorist Threat Assessment
- Physical Security Design
- Extreme Wind Modeling and Design
- Windstorm and Flood Assessment and Design

Consulting Services

- Blast Resistant Design
- Facility Siting
- Explosive Safety and Quantity Distance Sitting
- Blast Chamber Design
- Explosion Incident Investigation
- Explosion Testing
- Terrorist Threat Assessment
- Anti Terrorism and Force Protection (AT/FP)
- Physical Security Design
- Blast, Debris and Thermal Hazard Assessment



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CIVIL AND STRUCTURAL ENGINEERING ASSESSMENT AND SOLUTIONS

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Identifying and assessing civil structures is a key element of our engineering services, whether existing structures are required to withstand new demands and hazards, or new structures are being commissioned for bespoke projects.

ABS Group has extensive experience in analytical and design-based solutions; we help clients to identify and alleviate potential vulnerabilities in new or existing civil structures. Using a combination of onsite inspection, modeling software and structural calculations against harmonized international codes of practice, we can identify and mitigate hazard risk at a wide range of sites and mitigate the potential for operational losses at any point in the life span of their infrastructure.

Material Expertise

- Steel
- Reinforced Concrete
- Masonry
- Timber

Service Offerings

- Structural assessment and substantiation against static and dynamic load cases, including blast, seismic and other natural hazards
- Design of structural elements, connections and retrofit solutions to mitigate structural vulnerabilities
- Production of engineering substantiation calculations with technical specifications and drawings

Codes and Compliance Services

- American Society of Civil Engineers (ASCE)/ American Concrete Institute (ACI)
- Nuclear/Petrochemical Specific Standards
- Eurocodes
- Historic Codes of Practice (e.g. British standards)

We offer services supporting complex dynamic loading scenarios, including:

- Soil Structure Interaction
- Finite Element Assessments
- Coupled Structural Analysis with Mechanical Plants
- Non-linear Engineering Solutions (e.g. Seismic Time History Analysis)
- Blast, Fire and Thermal Structural Assessments.

NATURAL HAZARD RISK MANAGEMENT

ABS Group is a global provider of unbundled risk, safety and engineering solutions related to natural hazards, offering a broad range of services across many markets.

Scan or Click

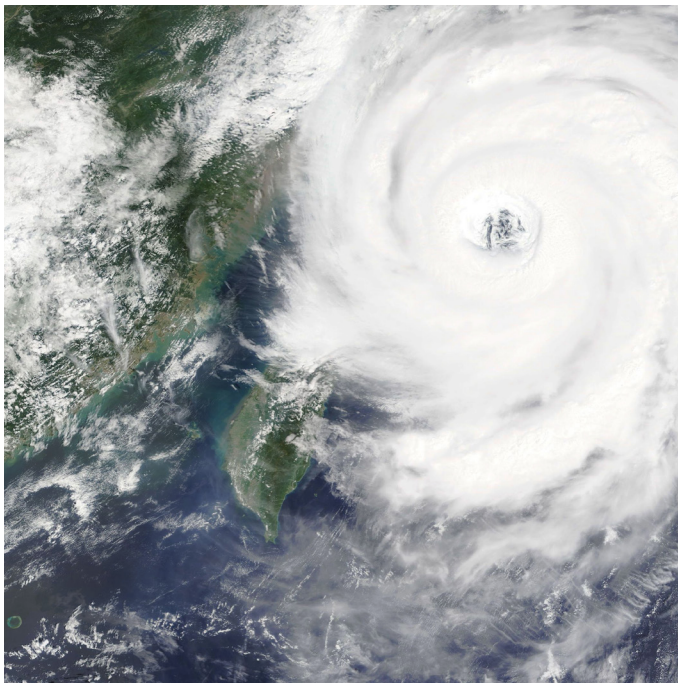
Our engineers have decades of experience performing natural hazard risk and vulnerability assessments, detailed design for new and existing structures and equipment installation mitigations. Additionally, our team provides design reviews and financial loss evaluations for seismic, hurricane, typhoon, flood and other severe natural hazards events (PML/MFL/NLE).

ABS Group has more than 45 years of on-site experience in risk assessment and mitigation analyses for virtually every kind of facility including single-site locations, commercial buildings and complex chemical, petrochemical, manufacturing, beverage, utility, energy transmission and distribution operations.

Our risk and engineering experts support our client's needs for a wide spectrum of natural hazards, including:

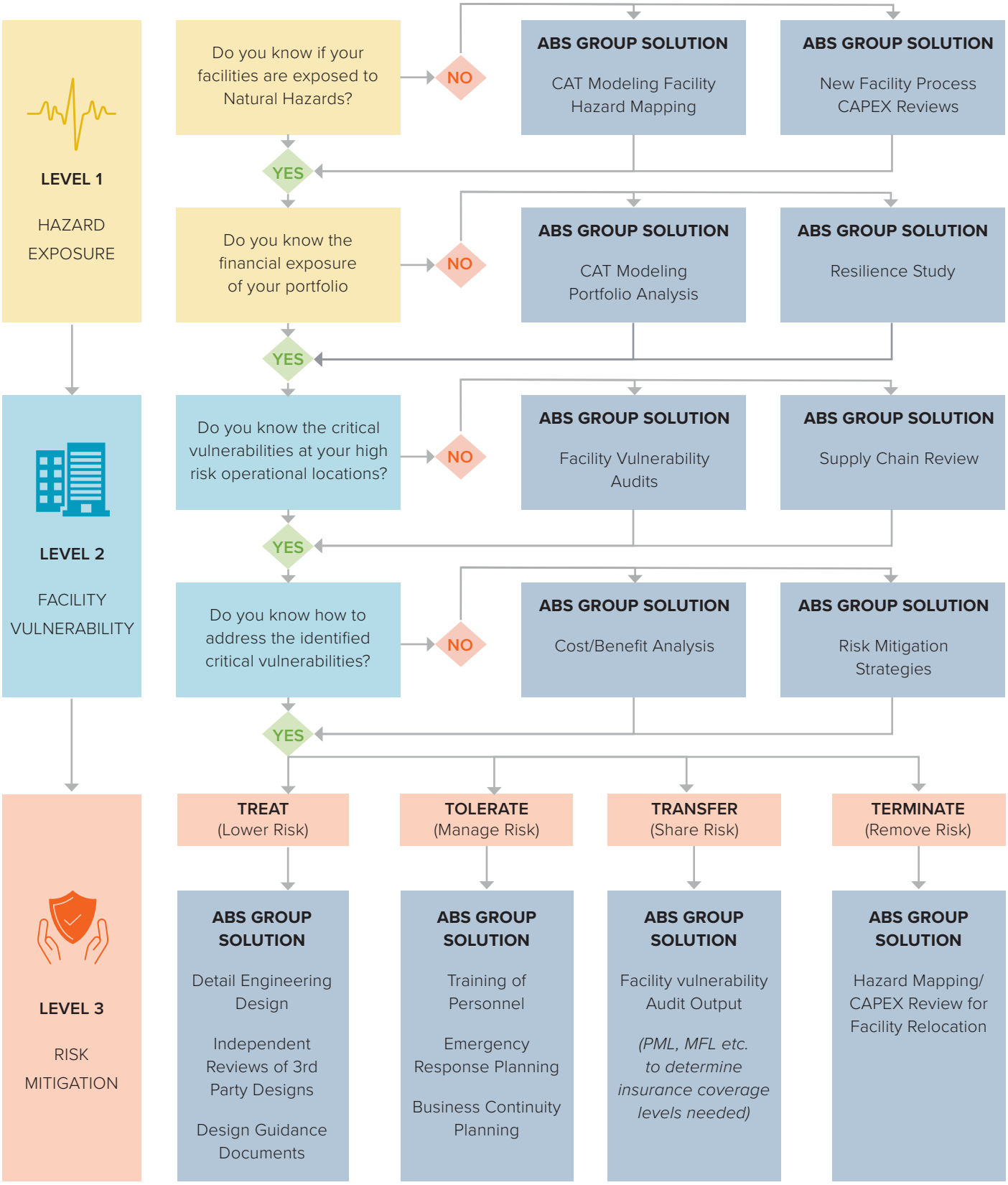
- Earthquake
- Windstorm
- Earthquake
- Windstorm
- Tornado
- Flood
- Volcanism
- Hail
- Lightning
- Tsunami

We support our clients from initial exposure assessments to the development and implementation of complete risk reduction programs that utilize our engineering expertise for detailed mitigation design and third-party independent technical reviews.



NATURAL HAZARD RISK REDUCTION PROGRAM

ABS Group's Natural Hazard Risk team employs a phased approach in their risk reduction programs to support and guide clients in managing natural hazard risk. The approach begins with a review of hazard exposures that drive risk reduction programs from critical vulnerability identification and assessment to targeted risk treatment strategies, all devised to enhance operational resilience.



FLOOD HAZARD MODELING AND MITIGATION DESIGN

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To inform proactive risk management, our flood risk assessments are carried out to determine the extent of flooding as well as the impacts on operations and facility assets. Utilizing a variety of applications, we produce 1D and 2D models to simulate flood events, enabling us to determine flood risk and to support clients in the management of that risk.

What is Flood Modeling?

Flood modeling uses predicted river flows, rainfall and coastal levels combined with topographic data and flow equations to generate flood risk information (such as depth, velocity, flood levels and hazards). The flood levels predicted by flood modeling inform the degree to which flooding can affect development potential, flood risk, and impact to assets, buildings and operations. Flood models are also used to:

- Calculate flood mitigation strategies
- Develop Flood Management Plans for emergency response
- Review risk and vulnerability of critical assets
- Develop flood protection schemes for whole facilities or individual facility elements

Our expertise and technical capability allows us to develop robust models from first principles or utilize existing models from previous studies, providing adequate data is available.

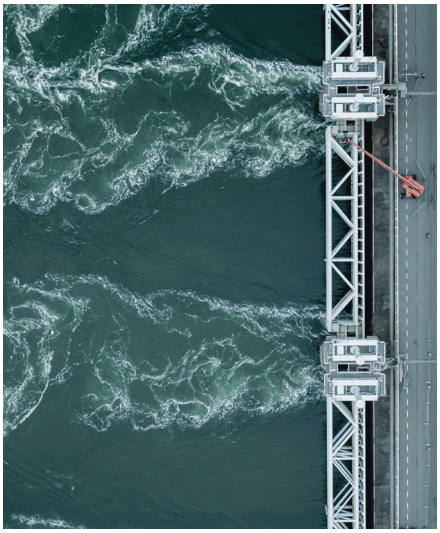
We specialize in modeling complex scenarios and assist in troubleshooting model performance issues for a wide range of organizations and market sectors.

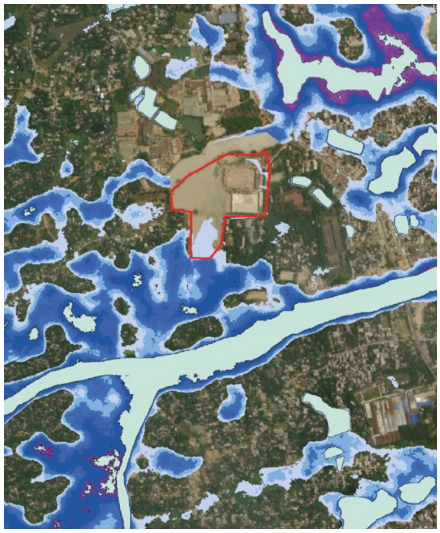
We have undertaken modeling studies for the following applications:

- Floodplain mapping (extent mapping/hazard
- Mapping/velocity depth mapping)
- Calibration studies
- Flood warning area studies
- Design flood modeling for informing flood risk assessment studies

As well as having the capabilities to produce our own flood models, we can provide independent quality assurance to third party models and expert technical consultation on internal projects.

Client organizations are assured of working with experienced staff members with a high level of technical expertise, whilst experiencing cost-effective solutions for your business.





FACILITY VULNERABILITY AUDITS

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ABS Group's Natural Catastrophe (NatCat) Facility Vulnerability Audits have been developed over many decades to allow clients not only to understand their risk but to proactively manage it. Audits can be managed remotely or onsite, with the scope based on individual client requirements. There are several key components to our audits and reports:

- Facility Specific Hazard Evaluation
- Vulnerability Evaluations
  - Buildings
  - Production Equipment
  - Utility Systems/Lifelines
  - Surrounding Infrastructure
  - Supply Chain/Stocks
- Personnel Safety/Human Elements
- Emergency Preparedness Reviews (ERP, BCP and more)
- Financial Loss Estimation (PML, MFL and more)
  - Pre and Post-Mitigation Estimates
  - Mitigation Cost Estimates
- Recommendations and Mitigation Options

CAT MODELING

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In terms of loss prevention, CAT Modeling Studies are the first steps to understanding the exposure and potential financial loss levels from natural hazards. They form the foundations for wider risk management strategies.

We utilize state-of-the-art CAT modeling platforms, which when combined with our 45 plus years of on-site vulnerability knowledge for extreme events, provides our clients with invaluable expertise and support in quantifying and managing natural hazards risk. From basic hazard mapping and establish exposure to complete CAT modeling portfolios we support our clients in fully quantifying exposures.

The output from the CAT modeling and strategic hazard reviews can be used to develop a risk reduction program to target locations shown to be in either a high hazard zone or sites significantly exposed from a financial perspective. Risk reduction programs include a range of techniques from desktop site reviews to on-site risk audits, to identify specific on-site vulnerabilities and suitable mitigation options to reduce risk levels.

Hazard Mapping:

- Geocoding of Locations
- Mapping Against Natural Hazards
  - Single or Multiple Hazards Considered
  - Single or Multiple Return Periods Considered
- Locaion Categorizing by High, Moderate, or Low Hazard
- Outline Guidance for the High Hazard Locations (Optional)
  - Applicable Design Loads
  - Design Codes and Standards Guidance

CAT Modeling

- Hazard Mapping Outputs, plus the following elements are contained in the reporting:
- Vulnerability Descriptors
- Financial Loss Estimates (NLE, PML, MFL)
  - Property Damage (PD)
  - Business Interuption (BI)
  - Single Site and Aggregate Losses
- Risk Ranking to identify High-Risk Assets
- High-Level Recommendations

ABOUT ABS GROUP

ABS Group of Companies, Inc. (www.abs-group.com), through its operating subsidiaries, provides data-driven risk and reliability solutions and technical services that help clients confirm the safety, integrity, quality and environmental efficiency of critical assets and operations. Headquartered in Spring, Texas, ABS Group operates with over 1,000 professionals in over 20 countries serving the marine and offshore, oil, gas and chemical, government, power and energy and industrial sectors. ABS Group is a subsidiary of ABS (www.eagle.org), one of the world's leading marine and offshore classification societies.

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