



Safety at High Latitudes: Safety and Health in Polar Environments

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Office of Polar Programs



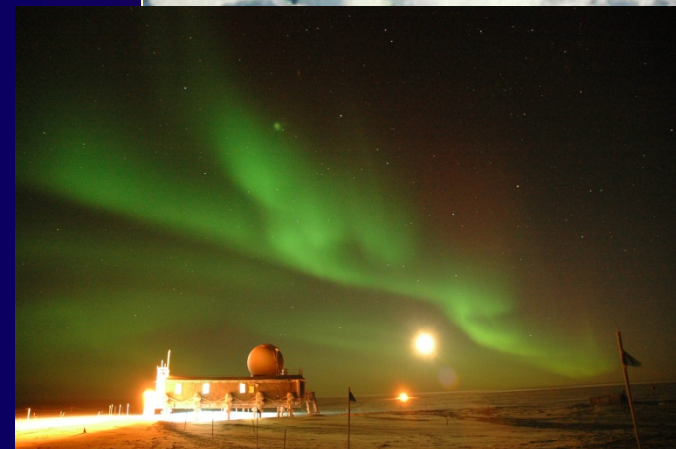
Two Programs

- Arctic and Antarctic
- Reasons:
 - Separate organizations and structures at NSF/OPP
 - Fundamental differences in programs:
 - Jurisdictional
 - Degree of control over population
 - Dispersion
 - Size of facilities



Arctic Program

- 130 projects, 600 people
- Alaska, Greenland, Canada, Russia
- Major facilities:
 - USCGC Healy
 - Summit Station
 - Toolik Field Camp
 - Barrow Arctic Science Consortium





Arctic Program Safety

- Most responsibility resides with grantee institutions and PIs
- Support contractor MAY provide:
 - Site management (only for larger sites)
 - Risk assessment for major projects
 - Training
 - Survival
 - Driving
 - Helicopter
 - Wilderness medical
 - Bears (also may provide armed escorts)
 - Specialized equipment, e.g., clothing, survival bags



Antarctic Program (USAP)

Overview

- Three permanent year-round stations, 3 logistics hubs, ~6 semi-permanent summer camps, numerous field camps
- Up to four major airports/skiways; numerous ski and helo landings in field; two seaports
- Three research/logistics ships + two Military Sealift Command supply ships
- Over 3000 persons during a season; 1600 on land and 300 at sea at peak; 300 during winter





USAP Facilities





McMurdo Station

- Operational hub
- Up to 1,100 persons in summer; 200 in winter
- ~85 buildings
- +45°F to -60°F
- 1 to 3 airfields
- Port facility





South Pole Station

- New elevated station
- 50 to 250 persons
- Skiway
- 0°F to -100°F
- 9,300 feet (10,500)





Palmer Station

- Serviced by ship from Punta Arenas, Chile
- 10 to 44 persons
- -10°F to $+40^{\circ}\text{F}$
- Windy
- Boat operations





Hazards in Polar Environments



- Cold, wind, low visibility, high physiologic altitude, UV
- Crevasses and unsafe sea ice
- Aviation operations:
 - Unprepared landing sites
 - High density altitude, wind, visibility, fast changing weather
 - Vast, trackless distances
 - Limited and remote search & rescue assets



More Hazards

- Typical risks of industrial and construction worksites
- Special science risks:
 - Labs
 - Drilling (mechanical and hot water)
 - Wildlife
 - Diving (15-30 divers making 400-500 dives/yr)
 - Small boat operations in cold water, wind, ice
 - Radioisotopes (~50 participants using 20+ substances)



Even More Hazards

- Unusual vehicles, heavy equipment
- Fire (dry, windy, scarce water, heating appliances, temporary structures)
- Ship and research vessel operations, including beach landings, stevedoring, deck operations
- Large quantity fuel storage and transfers
- Blasting and explosive storage (science & construction)
- Diverse population with some high turnover



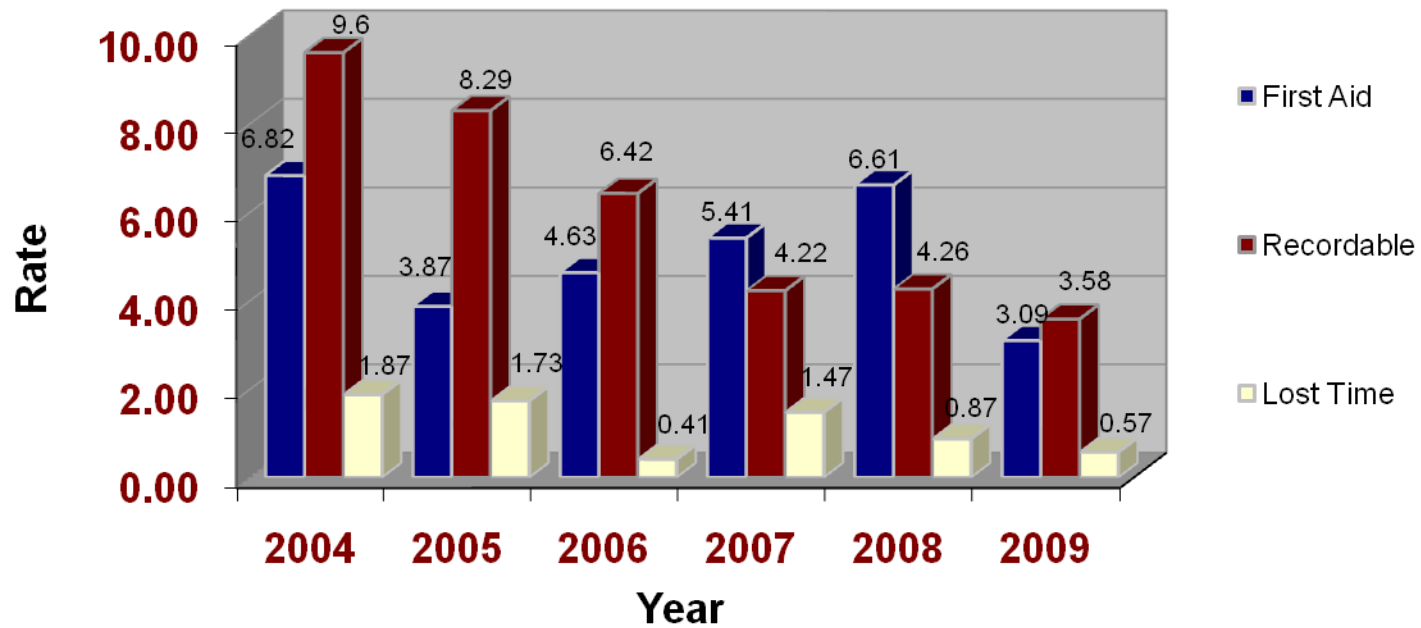
Off-Duty Hazards

- Slips and falls on slippery surfaces
- Recreation, including skiing, hiking, competitive sports



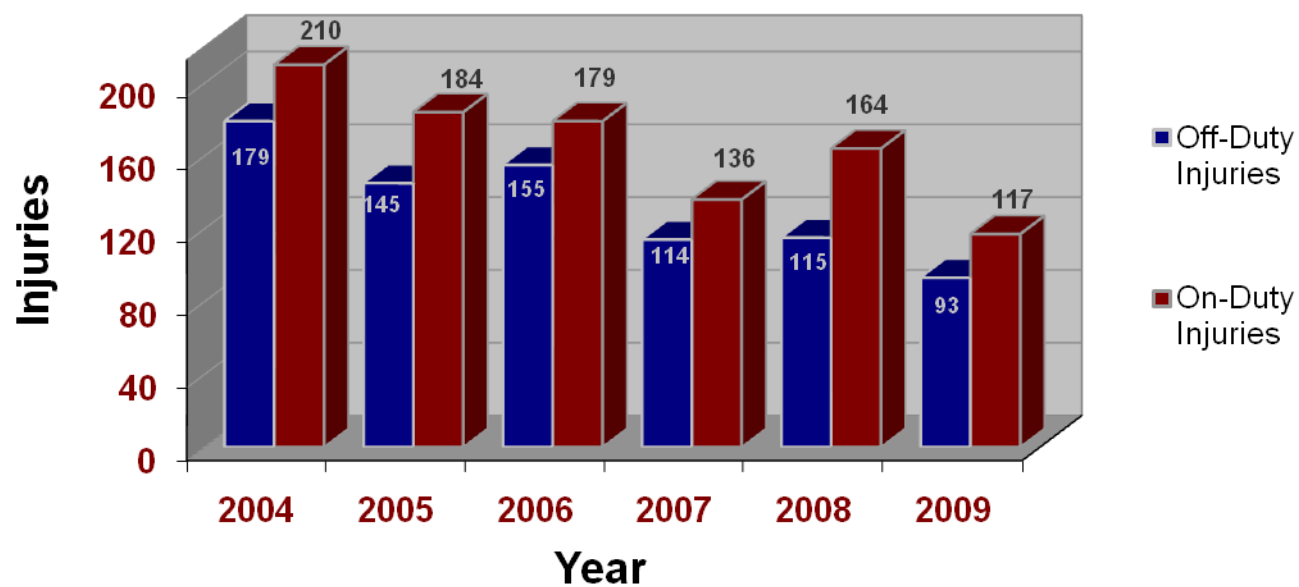


Contractor Injury Rates



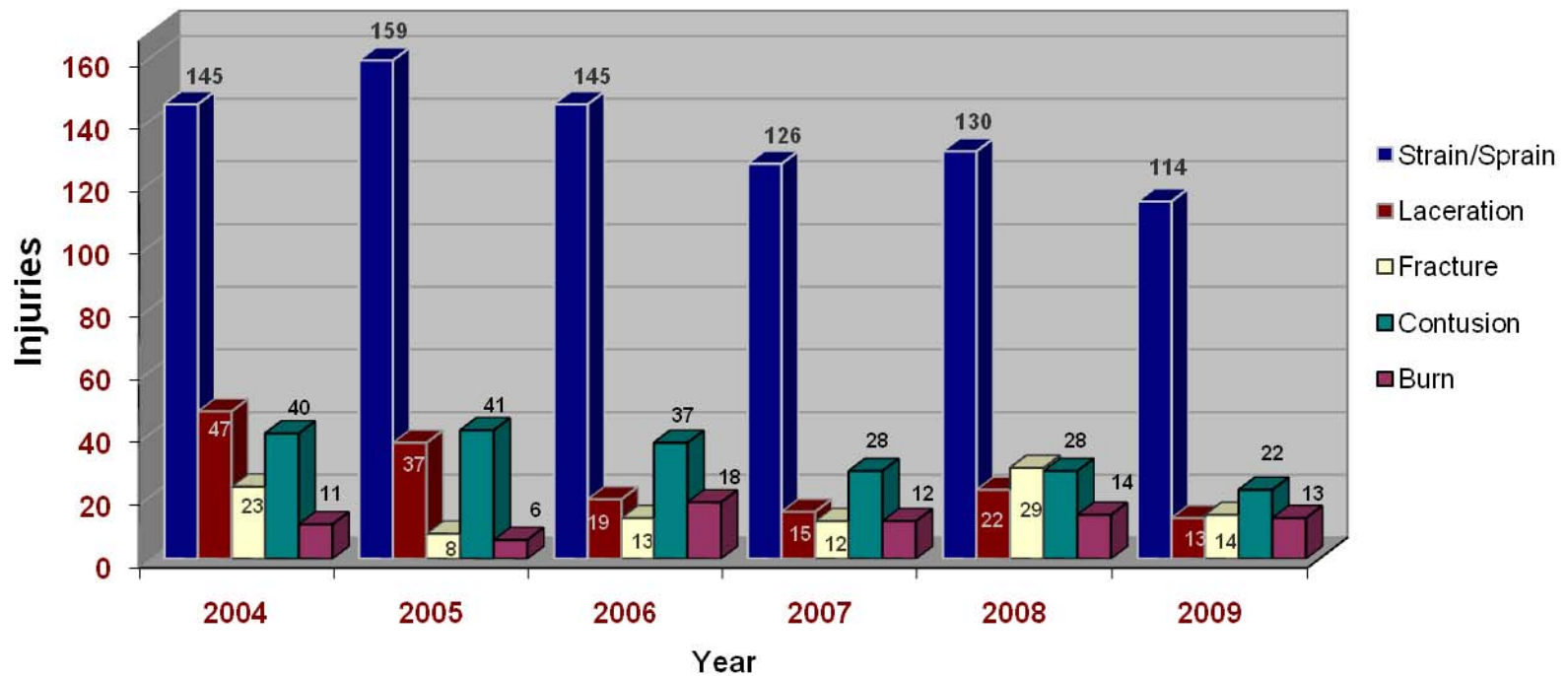


Injuries by Duty Status





Top Five Types of Injuries





Scope of Safety Officer Activities

- Safety direction and integration
- Contractor oversight
- Inter-organizational coordination
- International cooperation
- Project risk assessment and alternative design
- Authority Having Jurisdiction
- Mishap investigation and analysis



Scope – Special Programs



- Scientific diving
- Radiation safety
- Food safety
- Training, esp. field safety training
- Aviation safety



Scope – Shared Programs



- Emergency planning and management
- Fire protection (structural and ARFF)



Direction and Integration

- Prime contractor executes safety programs in field
- Combine compliance and safety risk management
- Compliance
 - OSHA, NRC, foreign countries
 - Applicable consensus standards
 - Unique risks not addressed by standards
- Risk-benefit analysis; some risks are inherent, but we take no *unnecessary* risks



Contractor Oversight

- Frequent communication
- Observation in field
- Collaboration on problems
- Mainly with contractor EH&S, but also with other divisions



Inter-organizational Coordination

- Coordination with and between contractors, military, subcontractors, grantee institutions, science investigators
- Investigators and grantee institutions sometimes must furnish own safety management



International Coordination



- Multinational projects
- Council of Managers of National Antarctic Programs (COMNAP)
- Antarctic Treaty & International Maritime Organization (IMO):
 - Tourism risks
 - Search and rescue



Project Risk Assessment

- High level, usually subjective, risk assessment for all funded, Antarctic-based projects
- Standard and unique controls may be specified to keep risks in line with benefits:
 - Standard programs include radiation safety, field safety training, explosives, diving, boating, altitude acclimatization
 - Alternative operations might be specified, e.g., standoff distances from calving glaciers, atmospheric monitoring
 - Dedicated risk management might be ordered for especially complex or risky projects



Risk Assessment

		People	Property	Project or Mission
I	Frequent	One or more events expected per year.		
II	Likely	Several events expected during a twenty year span or the life of a system.		
III	Infrequent	One event expected during a twenty year span or the life of a system.		
IV	Unlikely	Not expected to happen during the life of a system.		
A	Grave	Injury or illness resulting in death or a permanent total disability (illnesses include: asbestos, lung cancer, HIV from blood exposure, etc.)	Cost of damage is \$1,000,000 or greater	Ability to accomplish a critical project
B	Serious	Injury or illness resulting in permanent partial disability (illnesses include: isocyanate sensitization, Hepatitis B or C, etc.)	Cost of damage is greater than \$200,000 but less than \$1,000,000.	Major impact on ability to accomplish a critical project. Significant adverse media attention.
C	Moderate	Injury or temporary reversible illness resulting in loss of time from work beyond the day on which it occurred (illnesses include: metal fume fever, adult respiratory, food poisoning, etc.)	Cost of damage is greater than \$20,000 but less than \$200,000.	Moderate impact on ability to accomplish a critical project.
D	Minor	Injury or temporary reversible illness requiring more than simple first aid treatment (illnesses include: eye irritations, nose bleeds, etc.)	Cost of damage is greater than \$5,000 but less than \$20,000.	Minor impact on ability to accomplish a critical project. Operational insurance.

RISK ASSESSMENT:

- Significant hazards: Field work, high altitude, toxic or asphyxiant gases, hazardous fixed and operations, cryogenic gases, lava bombs, snowmobile ops on side of mountain
- Potential consequences (grave, serious, moderate, minor): Grave
- Probability (frequent, likely, infrequent, unlikely): Likely
- Risk determination (extreme, high, medium, low, very low): Extreme
- Residual risk after implementing controls specified below (extreme, high, medium, low, very low): Medium to high

SEVERITY	PROBABILITY			
	I	II	III	IV
A	1	1	2	3
B	1	2	3	4
C	2	3	4	5
D	3	4	5	5

1 Extreme risk
 2 High risk
 3 Medium risk
 4 Low risk
 5 Very low risk

- Review project description
- Identify the hazards that might lead to unwanted consequences
- Risk = Consequences x Probability they will occur
- Usually a subjective process based on history, experience, and training



Standard Risk Controls

REQUIRED CONTROL MEASURES:

Principal Investigator and support contractor shall ensure compliance with programs, training, and other measures checked below:

- Radiation Safety Program:** Activities using open or sealed radioisotopes or radiation-producing equipment must comply with the USAP Radiation Safety Program. Principal Investigators planning to use radioisotopes will complete a "Radioisotope Use Form" and obtain concurrence from their institutional Radiation Safety Officer.
- Explosives Safety Program:** Investigators proposing to use high explosives in their research shall identify a properly credentialed blaster or "shooter"; type and quantity of explosives and detonators should be identified; an explosives use plan, detailing storage and handling procedures in the field may be required.
- Scientific Diving Safety Program:** The Principal Investigator must complete and submit a scientific diving plan.
- Field Party Safety Procedures:** Field party members should have prior experience in similar environmental conditions; at least one member of the team must have appropriate first-aid/medical care experience; an experienced team leader responsible primarily for field operations and safety should be designated; persons possessing mountaineering or crevasse skills should be included on the team if the terrain warrants.
- Work at High Altitude (>2,500 meters):** Investigators deploying to altitudes in excess of 2,500 meters must adhere to the USAP Altitude Acclimatization Policy or an alternate plan approved by OPP/PEHS. Field deployment and logistics plans should be consistent with this Policy.
- Boating:** Investigators shall complete boating training and be properly equipped to conduct small craft operations.

- Recurring hazards allow standard controls for some risks



Unique Risk Controls

Other: Aviation operations subject to AMD approval. Dr. Xxx or knowledgeable member of party must monitor atmosphere with appropriate instrumentation on mountain and especially during excursions to the summit or crater to ensure NIOSH Recommended Exposure Limits for gases are not exceeded. Plume sampling flights should remain outside of normal lava bomb range to maximum extent possible. If incidence of lava ejecta increases over “normal” levels, flight operations may be curtailed and/or project may be withdrawn from mountain. Personnel should be kept to the minimum necessary to complete the project.

Additional sheet attached

- Controls for non-standard risks can be specified
- Hands-on risk management can be assigned to contractor or grantee institutions for especially complex or risky projects, e.g., major drilling projects



Finding

FINDING:

- Given the inherent risks of Antarctic operations, I find the risks associated with this proposal acceptable.
- I find this proposal to embody a potential for significant risk(s) which can be controlled to an acceptable level with the implementation of the controls and precautions specified above.
- I find this proposal's risk **unacceptable** and **the project should not proceed** without significant modification and re-assessment.

Signed:

James Karcher
Safety & Health Officer, OPP/PEHS

Date: 16 June 2009

File Copies in Safety and Health File and Proposal Jacket

- Third box not checked in recent history because PEHS and other stakeholders have collaborated to reduce high risks to acceptable levels by modifying plans and/or devising additional controls on risks
- Findings go to PI, Program Manager, support contractor



Authority Having Jurisdiction



- Approve code and standard waivers and alternative solutions
- Often requires collaboration with contractor and other stakeholders
- Alternative standards for temporary field structures





Mishap Investigation & Analysis

- Investigation of most mishaps done by contractor
- Oversight or participation by PEHS
- Mishap Analysis Board uses report and other data to define causes and order corrective actions:
 - In-house or external membership
 - Corrective actions specified and directed



Scientific Diving

- Exception to OSHA commercial diving standard
 - USAP Diving Safety Manual
 - USAP Scientific Diving Control Board
- Smithsonian Principal Advisor for Research Diving/Diving Safety Officer
- Contractor diving coordinator
 - Project support
 - Program management





Radiation Safety

- MOU with NRC to oversee radioisotope usage in Antarctica in accordance with NRC and DOT regulations
- Grantee institution Radiation Safety Officer must approve protocols for use of radioisotopes
- PEHS then authorizes specific usage
- Contractor oversees shipping, storage, use, waste disposal



Food Safety

- MOA with DoD Veterinary Service to provide:
 - Sanitation inspections of food storage and handling in Antarctica and transshipment points
 - Inspections at some field camps
 - Food receipt inspections





Training

- Area orientation, including weather and survival
- Job specific (hazcom, fall protection, etc.)
- Field safety training
 - Snowcraft – two day field survival and equipment use
 - Snowcraft Refresher – Indoor review
 - Helicopter orientation
 - Environmental orientation
 - Sea ice



Aviation Safety

- Air Force and Air National Guard employ armed service safety programs
 - C-17, LC-130, occasional C-5
- Civilian aviation contractors comply with USDOJ Aviation Management Directorate safety directives
 - Twin Otter, BT-67 (DC-3T), AS350, Bell 212
- PEHS coordinates with military and AMD
- PEHS may participate in mishap investigations





Emergency Planning & Management

- Comprehensive Emergency Management Plan at McM and emergency plans at other stations
- Emergency Operations Center at McM
 - Cooperation with Antarctica New Zealand
- Rescue Coordination Centers (NZ, Chile, Argentina)



Fire Protection

- Structural Fire Protection
 - Fire department at McM
 - Brigades at SPS and PAL
- Aircraft Rescue and Fire Fighting (ARFF):
 - Firefighting agent quantities at McM and SPS as required by Air Mobility Command
 - Unique ARFF vehicle fleet





Questions?

