ABS Safety, Human Factors & Ergonomics Activities
Addressing the Human Element

- Mission is to:
  - Improve human performance and safety
  - Reducing human error
  - Increasing productivity
- ABS has organized its approach around four areas
- We have advanced projects and products in support of these areas
ABS Human Factors Products/Current Projects

- Design, layout and ambient environment
  - Guidance Notes on the Application of Ergonomics to Marine Systems
  - Guidance Notes on the Ergonomic Design of Navigation Bridges
  - Guides for Crew Habitability on Ships Offshore Installations Workboats or MODUs
    - Crew Habitability on Accommodation Vessels
  - Guides for Passenger Comfort on Ships and Yachts
  - Guide for Means of Access for Inspection
  - Guide for ILO MLC Title 3 - Accommodations
  - Guide for Ergonomic Notations
  - Guidance Notes for Vibration and Noise Control Design
  - Guidance Notes for Ergonomics to Marine Engineering Spaces
ABS Human Factors Products/Current Projects

- Management and Organization
  - Guidance Notes for Implementing HFE into the Design of Offshore Installations
  - Guidance Notes on the Investigation of Marine Incidents
  - Guidance Notes on the Safety Culture and Leading Indicators for Safety assessments
    - Offshore Production
    - Offshore Drilling
  - Guidance Notes for the Development of Procedures and Manuals

- People
  - Research on human performance, health hazards and shock
  - Improving marine personnel safety (MPS)
Proper Label/Instructions?
Guidance Notes for the Application of Ergonomics Contents

- Controls, displays, alarms and their integration
- Video-display units and workstations
- Valves – operation, location and orientation
- Labeling, signs, graphics, and symbols
- Stairs, vertical ladders, walkways, and ramps
- Maintenance and materials handling
- Crew habitability
- Application of ergonomics to design
- Anthropometrics
Field of View

* Dimensions are based on North American males.
Handrail with Toeboard

**FIGURE 1**
Handrail Dimensions with a Toeboard

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Preferred Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Height of handrail</td>
<td>1000 mm (39.0 in.)</td>
</tr>
<tr>
<td>B Height of intermediate rail above toeboard</td>
<td>425 mm (16.75 in.)</td>
</tr>
<tr>
<td>C Outside diameter of handrail</td>
<td>40 mm (1.5 in.) Minimum</td>
</tr>
<tr>
<td></td>
<td>50 mm (2.0 in.) Maximum</td>
</tr>
<tr>
<td>D Height of toeboard</td>
<td>100 mm (4.0 in.)</td>
</tr>
<tr>
<td>E Gap between toeboard and surface</td>
<td>6 mm (0.25 in.)</td>
</tr>
</tbody>
</table>
Why Design for Habitability?

- Important for recruiting
  - Access to internet and telephone
  - Exercise equipment, satellite TV, library and DVDs (habitability)

- Important for retention
  - Better benefits (financial and personal (e.g., health insurance)
  - Better onboard living conditions (habitability)
  - Access to family (e.g., internet)

- Improve crew performance
  - Provide an environment for the crew to rest and recover

Source: ShipTalk Seafarer Attraction and Retention
ABS Habitability Guidance

- Guides
  - Crew Habitability on Ships
  - Crew Habitability on Workboats
  - Crew Habitability on Offshore Installations
  - Crew Habitability on MODUs

- Notations Offered
  - HAB, HAB+, HAB++
  - HAB(WB), HAB+(WB), HAB++(WB)
  - HAB(OS), HAB+(OS), HAB++(OS)
  - HAB(MODU), HAB+(MODU), HAB++(MODU)
ABS Habitability (HAB) Guidance

- Crew accommodations
  - Access/egress and crew cabins
  - Sanitary spaces and offices
  - Food services areas
  - Recreational facilities
  - Laundry and medical areas

- Ambient environment
  - Human whole-body vibration
  - Noise
  - Indoor climate
  - Lighting
Noise

- Adverse and/or improper levels can:
  - Cause speech interference
  - Interfere with concentration and thought processes
  - Disrupt sleep
  - Cause fatigue and aggression

- Appropriate noise levels can:
  - Provide an environment for improved human performance
  - Have a positive psychological effect on people
Big Contributor: HVAC Noise

- Potential solutions to HVAC-induced noise:
  - As high as 2 to 8 dB contributed noise, near speech frequencies
  - Design-related:
    - Configurations including largest feasible duct size, gradual turns
    - Use of HVAC silencers and/or resonators
    - Tuning of resonators to the blade frequency
    - Reduction of pressure changes
  - Installation-related:
    - Proper supports for exhaust and piping systems
    - Secure ventilation ductwork piping systems will reduce vibration against shipboard structures
Lighting

- Objective is to provide lighting to accommodate crew visual task performance and safety

- Criteria provided for:
  - Entrances and passageways
  - Cabins, staterooms and sanitary spaces
  - Dining spaces
  - Recreation spaces
  - Crew work spaces
Lighting Requirements

- Relationship of age and light required for reading small print

Source: Phillips Lighting
Ergonomic / Safety Hazards

- Appropriate design of the workplace?
Safety Culture & Leading Indicators of Safety

- Published January 2012
- Directed at cargo-carrying vessel owners and operators
- Contents
  - Administering the survey
  - Safety culture questionnaire
  - Safety factors
  - Analysis with worked examples
  - Objective and subjective leading indicators
  - Interpreting the results
  - Action plan
  - Comprehensive appendices
Safety Culture Survey (Shipboard & Shoreside)

- 40 Statements/Questions (in 3 sections)
  - Ship safety
  - Health and safety
  - Respondent’s own job
- 8 Safety Factors (5 statements per safety factor)
  - Communication (COM)
  - Empowerment (EMP)
  - Feedback (FDB)
  - Mutual trust (MTR)
  - Problem identification (PID)
  - Promotion of safety (POS)
  - Responsiveness (RSP)
  - Safety awareness (SAW)
- Demographics, free-text and optional questions
Mariner Personal Safety (MPS)

- Objective obtain and review incident and close call reports
- Collected approximately ~ 85,000 records (injuries and close calls)
- Database represents more than 1,600 vessels and 45,000 mariners
- Constructed a database to:
  - Identify trends
  - Create benchmarking statistics
  - Identify potential corrective actions
  - Identify potential lessons learned
- Develop and share results
ABS Guide for Ergonomic Notations

- Owner/Operator
  - Interested in improving crew safety and productivity
  - Decrease costs
- Addresses structural aspects of four vessel areas
- Can be applied to ships or offshore structures
- Ergonomic notations for:
  - Topside interface design (ERGO TOP)
  - Enclosed space and hull interface design (ERGO ES)
  - Maintenance access and design (ERGO MAINT)
  - Valve locations, access and operation (ERGO VALVE)
ABS Guide for Ergonomic Notations

- Requirements limited to human and vessel structure compatibility
  - Anthropometry
  - Biomechanics
  - Reach and working envelopes

- Cognitive factors not addressed (e.g., information display)

- Environmental factors not addressed (e.g., noise, vibration)
ERGO HULL (Means of Access – Examples)
Ergonomic / Safety Hazards

- Appropriate layout of equipment and access aid?
Crew Injuries Related to Access Aids (MPS Data)

Chart data represents ~24% of all crew injuries
Near Misses Related to Access Aids (MPS Data)

Percent of Near Misses

- Ladders: 25%
- Hatches: 17%
- Valves: 33%
- Stairs: 3%
- Walkways and Ramps: 5%
- Platforms: 4%
- Handrails: 6%
- Handles: 7%
- Climber Safety Devices: 1%

Chart data represents ~22% of all crew near misses
FIGURE 12
Deck Edge and Elevated Walkway Rail Dimensions

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Upper rail courses vertical separation</td>
<td>≤ 380 mm (15 in.)</td>
</tr>
<tr>
<td>B Lower rail course vertical separation</td>
<td>≤ 230 mm (9 in.)</td>
</tr>
<tr>
<td>C Vertical stanchion separation</td>
<td>≤ 1525 mm (60 in.)</td>
</tr>
<tr>
<td>D Rail height from deck to top of rail*</td>
<td>≥ 1070 mm (42 in.)</td>
</tr>
<tr>
<td>E Toeboard height</td>
<td>100 mm (4.0 in.)</td>
</tr>
</tbody>
</table>

*Note: Assumes handrail diameter of 50 mm (2 in.).

Guardrail Design
Historic HFE Challenges

- Understanding who is responsible for HFE
- Owner commitment
- Mandate of HFE
- Assimilation of HFE
- Effective HFE planning
Offshore Asset Example
Commitment to HFE

● Who is responsible?
  ■ Owner and the contractor

● Clearly defined HFE mission, vision and objectives

● Establish responsibility and accountability for HFE

● Identification of the HFE leads, both for the owner and contractors
Commitment to HFE - Objectives

- Ensure responsibility and resources for HFE
- Establish accountability for HFE
- Ensure HFE activities are integrated into the project schedule
- Create awareness of HFE at all levels of the project design team
- Mandate of HFE via the design specification
Assimilation of HFE

- HFE placement in the design program
- HFE considered a design discipline
- HFE program monitoring
Effective HFE Planning (HFEIP)

- Describes Owner and Contractor’s responsibilities
- Defines HFE mission, vision, and objectives
- Identifies personnel and milestones
- Presents HFE schedule and HFE program management
- Covers from Contractor selection through operations
- Developed by Owner & Contractor
Key HFE Plan Tasks

- Assist in the review of early project design documents
- Identify HFE tasks and prepare the HFE plan
- Select/write the HFE design aids
- Conduct training
- Develop HFE tracking database
- Conduct drawing/model reviews

<table>
<thead>
<tr>
<th>HFE Activity</th>
<th>Project Life Cycle Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Concept</td>
</tr>
<tr>
<td>1 Provide HFE Training</td>
<td>0</td>
</tr>
<tr>
<td>2 Review of Specifications</td>
<td>0</td>
</tr>
<tr>
<td>3 Development of Design Aids</td>
<td>0</td>
</tr>
<tr>
<td>4 HFE Tracking Database</td>
<td></td>
</tr>
</tbody>
</table>

ABS
Key HFE Plan Tasks

- HFE and vendor supplied equipment
- Prioritize HFE efforts for systems/equipment
- Facility labeling program
- Review operations, maintenance, and training materials/manuals
- Participate in special design studies
- Prepare progress reports
- Develop lessons learned
**HFE Issue Example**

<table>
<thead>
<tr>
<th>BEFORE (문제점 수정 전)</th>
<th>AFTER (문제점 수정 후)</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Diagram" /></td>
<td><img src="image2" alt="Diagram" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PROBLEM (문제점 설명)</th>
<th>RESOLUTION (해결 방안)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Modify escape route as straight as possible</td>
<td>• Modified escape route. (closed)</td>
</tr>
</tbody>
</table>
HFE Issue Example
Prioritize Equipment / System HFE

- Review the equipment, systems, and subsystems lists to identify potential HFE activities
- Identify those parts of the design, which will receive detailed HFE attention
- Prioritize the various equipment, systems, subsystems, according to HFE concerns and importance

<table>
<thead>
<tr>
<th>System</th>
<th>HFE Priority</th>
<th>HFE Areas of Concern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety Systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency shutdown system</td>
<td>High</td>
<td>Control Station, design, location, orientation, labeling and accessibility</td>
</tr>
<tr>
<td>Structure</td>
<td>Medium</td>
<td>Ease of access to voids and tanks, man-way and hatch dimensions, personnel evacuation, PPE considerations</td>
</tr>
<tr>
<td>Power and Utility Systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Main power generation and distribution</td>
<td>High</td>
<td>Equipment removal and replacement, control panel design and layout</td>
</tr>
</tbody>
</table>
Labeling Program

- From a safety and operability perspective:
  - A well-labeled facility is one of the most significant HFE contributions that can be made

- Owner from a major Gulf of Mexico E&P company rated “good labeling” as one of the most important HFE contributions to their series of new offshore installations
Key Lessons Learned

- Commitment from the Owner is essential
- Early and continuous involvement of HFE is needed for success
- Effective HFE Planning is crucial
- HFE awareness training for all project personnel
- Placement of the HFE activity to promote interaction with the other design disciplines
ABS Guidance Note

- Implementation of Human Factors Engineering into the Design of Offshore Installations
  - ABS Project
  - Based on the successful application of Human Systems/Factors Integration
  - Published