REAL TIME UNDERKEEL CLEARANCE SYSTEMS

FREMANTLE PORTS

A PERSPECTIVE OF POSITION, NAVIGATION and TIMING

FREMANTLE PORTS

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WHAT DOES IT ALL MEAN?

• THE FREMANTLE PICTURE
• STATIC METHODOLOGY
• DUKC METHODOLOGY
• DUKC OUTPUT AND WHAT DOES IT MEAN TO NAVIGATION
• LIMITATIONS/BENEFITS
• CHALLENGES
• RESOLUTIONS

HISTORY

• PRIOR TO 1991 – DEEP DRAFT VESSELS UTILISED STATIC UKC
• BASED ON PAST EXPERIENCE
• NO INCIDENTS – NO REASON TO QUESTION METHODS
• APRIL 1991 – HM IMPOSED RESTRICTIONS THROUGH SUCCESS AND PARMELIA (S&P) CHANNELS DUE TO SILTATION
• DECLARED WIDTH DECREASED FROM 152 – 125M
• DECLARED DEPTH 13.7M
• MAX DRAFT 12.65
• MAX BEAM 40M
• THERE WAS ADEQUATE DEPTH IN DWC

MAINTENANCE DREDGING REQUIRED

THE FOLLOWING STUDIES UNDERTAKEN:
• DEVELOPMENT OF UKC PROGRAM FOR S&P CHANNEL
• STUDY TO DETERMINE SAFE UKC IN S&P
• DEEPENING REQUIRED IN S&P TO BE IN LINE WITH DWC
• 1994 – DREDGING TO 14.7M IN S&P AND IMPLEMENTATION OF REAL TIME WAVE AND TIDE DATA TO UKC
• 2006 – LIVE INPUT OF ALL WAVE AND TIDE DATA TO DUKC PROGRAM
• 2009 – SERIES 4.5 : ENHANCEMENTS

HISTORY

Inner Harbour
FREMANTLE

Outer Harbour
KWINANA

Arriving or departing the Inner Harbour 13.5m (depth IH 14.7m)

Arriving or departing ALCOA Jetty 10.60

Arriving or departing Bulk Terminal 10.60

Arriving or departing Cockburn Sound 13.00

13.90

13.90
**THE ELEMENT OF RISK**

\[ \text{Risk} = \text{Probability} \times \text{Consequence} \]

**Exposure Likelihood**
- Grounding
- Pollution
- Channel Closure
- Resulting in Economic Loss
- Reputation Damage

Based on experience and gut instinct (good luck?) but:

**What is the real/mathematical likelihood?**

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**Static Methodology**

- Measured waves
- Measured tide and currents
- Measured wind and pressure
- Latest sounded depths
- Astronomical tides
- Ship in given load state
- Ship speed envelopes

**Static Example**

SUCCESS AND PARMELIA CHANNELS STATIC RULE IS 13% OF DRAFT (NOV-APR) AND 14% (MAY-OCT)

- Charted Depth 14.7M
- Transit Time 30 MINS
- 15.6M Required for Draft of 13.8M (TIDE 0.9M)

Static Tidal Windows: Passage Commencement Windows

Window 1: Open Close

**Tide Output**

**Static Methodology**

- Measured waves
- Measured tide and currents
- Measured wind and pressure
- Latest sounded depths
- Astronomical tides
- Ship in given load state
- Ship speed envelopes

**Dukc® Methodology**

- Measured waves
- Measured tide and currents
- Measured wind and pressure
- Latest sounded depths
- Astronomical tides
- Ship in given load state
- Ship speed envelopes
Channel Depth, Survey Tolerance & Siltation Allowance
Underkeel Clearance = Channel Depth - Survey Tolerance - Siltation Allowance

Astronomical Tide and Tidal Residual
Underkeel Clearance = Channel Depth - Survey Tolerance - Siltation Allowance
+ Astronomical Tide ± Tidal Residual

Vessel Draft
Underkeel Clearance = Channel Depth - Survey Tolerance - Siltation Allowance
+ Astronomical Tide ± Tidal Residual
- Vessel Draft

Squat
Underkeel Clearance = Channel Depth - Survey Tolerance - Siltation Allowance
+ Astronomical Tide ± Tidal Residual
- Vessel Draft
- Squat
- Heel

Wave Response
Underkeel Clearance = Channel Depth - Survey Tolerance - Siltation Allowance
+ Astronomical Tide ± Tidal Residual
- Vessel Draft
- Squat
- Heel
- Wave Response
Why is the Port Unique?

- Utilises DUKC for imports
- First port to use for container vessels
- Majority of ports utilise DUKC for exports

The Challenge

- Reliability of stability data particularly drafts from arriving vessels
- Max draft to load to required in advance of known weather parameters
- Vessels closed out on arrival
- Availability/reliability of sensor inputs
- Acceptance by ship’s masters and agents
- Update time required to integrate new survey data into existing model
THE RESOLUTION

- PILOTS VERIFY DRAFT ON ARRIVAL AGAINST ISSUED DUKC REPORT
- MAX ECONOMICAL DRAFT PROVIDED TO SHIPPING COMPANY AND AGENTS BASED ON AVERAGE WEIGHTED 6 DAY SEA LEVEL
- RISK ABSORBED BY SHIPPING COMPANY HOWEVER PORT GIVES PRIORITY TO DUKC VESSELS AND WILL MANAGE TRANSITS TO ASSIST
- ENHANCEMENTS TO PREDICTIVE MODEL
- VTS ACT AS REAL TIME DUKC INFORMATION SOURCE
- ACTIVE ENGAGEMENT WITH VENDOR FOR SOUNDING UPDATES

WHY DO WE TRUST IT?

- EXTENSIVE FULL SCALE VESSEL MOTION ANALYSIS
  - DGPS RECEIVERS ON BOW AND BRIDGE WINGS
- INTERNAL VALIDATION BY REQUESTING THE ECHO SOUNDER RECORDINGS FROM VESSELS AND CROSS REFERENCING TO DUKC PREDICTIVE REPORT
- WE CHALLENGE IT AND VALIDATE SENSOR INPUTS THROUGH EXTERNAL REFERENCES
- USER ACCEPTANCE TESTING
- WE ARE ACTIVE IN THE DEVELOPMENT OF ENHANCEMENTS FOR THE SYSTEM

WHAT DOES IT MEAN

- INCREASE IN DRAFT THROUGH SUCCESS AND PARMELIA CHANNELS.
  - MAXIMUM DRAFT (1991) 12.65M
  - MAXIMUM ECONOMICAL DRAFT (2007) 13.8 – 14.0M
  - DREDGED DEPTH ADDITIONAL 1M
  - DELAYED MAINTENANCE AND CAPITAL DREDGING
  - A DEFENSIBLE DETERMINATION OF DUKC AND THEREFORE BETTER MANAGEMENT OF RISK AND SAFETY
  - 20CM INCREASE IN DRAFT TO A TANKER = 2000MT CARGO

ADDITIONAL USES

- OPTIMISATION OF CHANNEL DESIGN AND INNER HARBOUR DEEPENING
  - PIANC DESIGN CRITERIA
  - DYNAMIC UNDER-KEEL CLEARANCE SIMULATIONS
  - ALLOWING FOR BOTTOM CLEARANCE
  - MANOEUVRABILITY MARGINS
  - AVERAGE WEATHER CONDITIONS AND VESSEL PARAMETERS
  - % ACCESS TO BERTH
  - SHIP SIMULATION
  - ALLOWING FOR UP TO MAXIMUM WEATHER CONDITIONS AND VESSEL PARAMETERS

RISK MANAGEMENT

- DUKC REQUIREMENT FOR INNER HARBOUR >= 12.2M
- “APL TOPAZ” (CONTAINER VESSEL) ARRIVAL DRAFT 11.6M
- DWC DECLARED AT 15.2M

RISK MANAGEMENT
RISK MANAGEMENT

- ASIAN JADE (TANKER)
  - LBP 234M
  - BEAM 42M
  - DRAFT 13.82M
- CONDITIONS
  - TIDAL RESIDUAL -0.1M
  - SWELL HEIGHT 0.89M
  - TP SWELL 15SEC
  - DIR SWELL 265 – 315 DEGREES

VESSEL COMPARISON

MSC Confidence (Cont) @ 13.55m

British Hazel (Tanker) @ 13.55m

THE CHALLENGE

- MAX DRAFT TO LOAD TO REQUIRED IN ADVANCE OF KNOWN WEATHER PARAMETERS
- RELIABILITY OF STABILITY DATA PARTICULARLY DRAFTS FROM ARRIVING VESSELS
- AVAILABILITY/RELIABILITY OF SENSOR INPUTS
- VESSELS CLOSED OUT ON ARRIVAL
- UNDERSTANDING OF DUKC BY MASTERS
- EFFECTIVE MASTER PILOT EXCHANGE
- MANAGING AGENT AND PRINCIPAL EXPECTATIONS

OTHER COMPLICATIONS

- DUKC DATA ISSUED TO PILOTS NO LESS THAN 2 HOURS BEFORE TRANSIT
- MET CONDITIONS MAY CHANGE
- ACTUAL POSITION OF SHIP/PILOT DURING COMMENCEMENT OF TRANSIT MAY NOT EQUATE TO THE FIRST MODELLED WAYPOINT
- AFFECTS TIMING RISK WHEN WINDOWS ARE TIGHT
- AGENTS ENTERING IN STABILITY DATA THROUGH PORT MANAGEMENT INFORMATION SYSTEM
- AS SUPPLIED FROM SHIP
- AGENT UNDERSTANDING
WHAT NEEDS TO BE DONE

• RECOGNITION OF REAL TIME UNDERKEEL CLEARANCE SYSTEMS AS AN AID TO NAVIGATION AND ENSURE THAT STANDARDS ARE ESTABLISHED
• TRAINING FOR MARINERS (MASTERS AND PILOTS)
• AGENT EDUCATION

A SYSTEMS APPROACH

• IDENTIFY THE RISKS
• ANALYSE
• DEVELOP MITIGATION STRATEGIES
• IMPLEMENT A SAFETY MANAGEMENT PLAN IN LINE WITH PORT SAFETY MANAGEMENT CODE
• TRAINING (and understanding)
• CONTINUOUS MONITORING AND QUESTIONING

QUESTIONS?