MANAGING RISK

Nauticus Hull for CSR Tank

Software with unique efficiency and flexibility to support hull design according
IACS Common Structural Rule for Oil Tankers

Software offering is part of DNV's commitment to support the industry

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1. DNV need to have a production tool for hull approval according to CSR Tank:
   - To give timely response and assistance to owners and yards
   - To provide efficient, professional and smooth hull approval ensuring safe design
2. DNV has a strategy to offer the best Class software support for CSR for the yards:
   - To support yards develop safe hull design in an efficient way
   - To ensure smooth interaction between yard and Class

Nauticus Hull for CSR Tank – available to the industry from January 2006

Nauticus Hull for CSR Tank

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- Builds on Nauticus Hull since 1996 (PILOT since 1970's)
- Developed in parallel with CSR Tank since 2003
- CSR Tank continuously tested on Nauticus Hull
  - Frequent CSR Tank test releases and patches – one updated version every second month during 2005
  - Official release supporting Final Rules on January 9, 2006 only 3 weeks after Rules adopted by IACS Council
- During April 2006, DNV again made a new release of its Nauticus Hull software available to the industry, this time with an even wider coverage of the latest Rules updates and clarifications.

Section Scantlings

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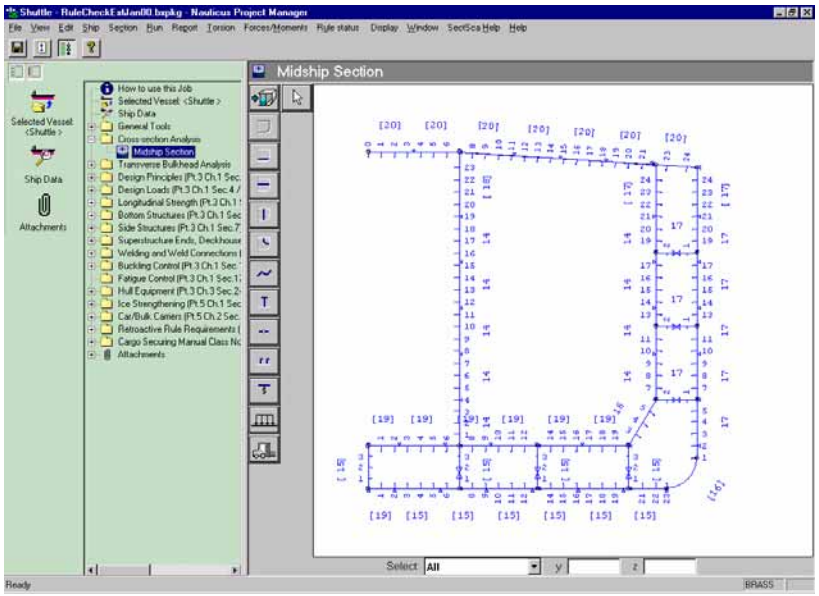
- Market-leader software Section Scantlings has been upgraded to cover CSR Tank :
  - -Hull girder requirements
  - -H-ULS (hull girder ultimate capacity)
    - single step
    - multistep
  - -Yielding
    - Local pressures
  - -Buckling
    - DIN Standard
  - -Advanced buckling (PULS)
  - -Minimum scantlings
  - -Fatigue



- With the latest CSR Tank enhancements,
  the program scope is further extended and user-friendliness
  further improved.

Direct strength analysis - cargo model FE model

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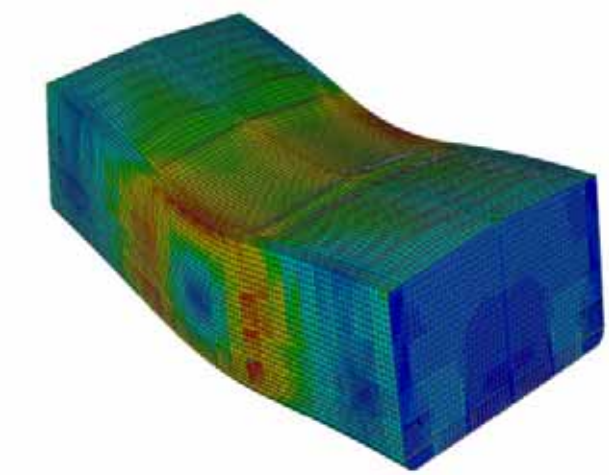
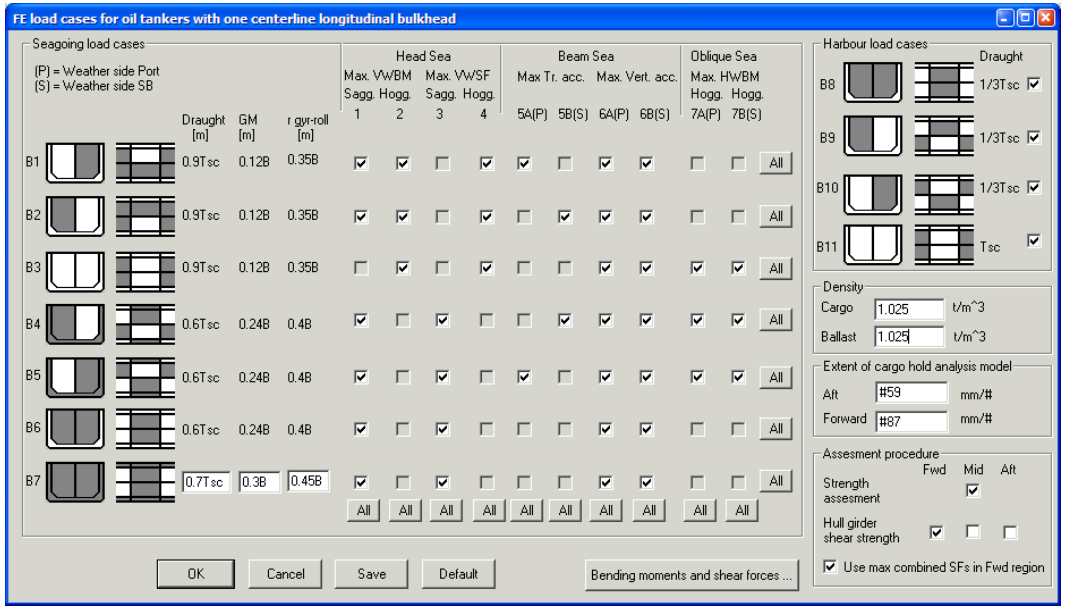
- Support FE analysis for tankers according to CSR Tank
  - Three cargo tanks about midship
  - Co-centric beams
  - Modified boundary cond. and spring calculation
  - New loads (incl. Fatigue)
  - Automatic application of longitudinal bending moment and vertical shear
  - Gravity loads added
- Export to MSC Patran, import from MSC Nastran
- User are in control – no ”black-box”!





Cargo model FE model - Automated Strength Assessment

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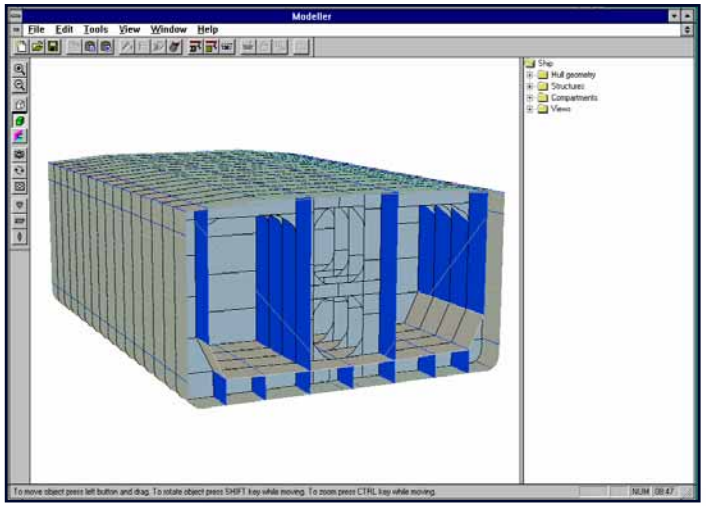
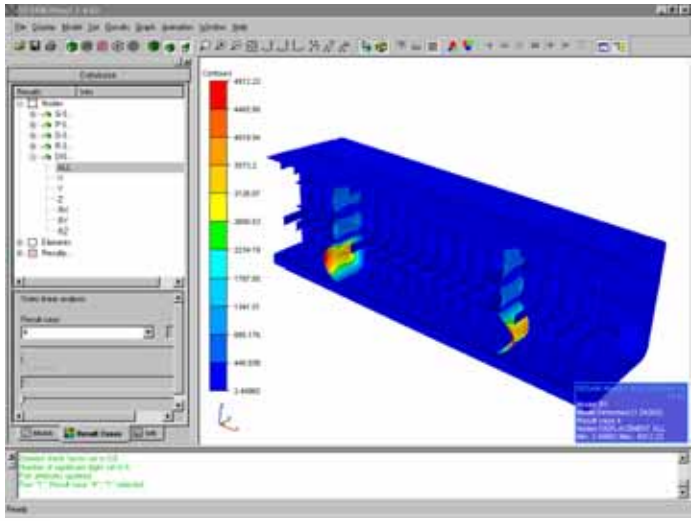
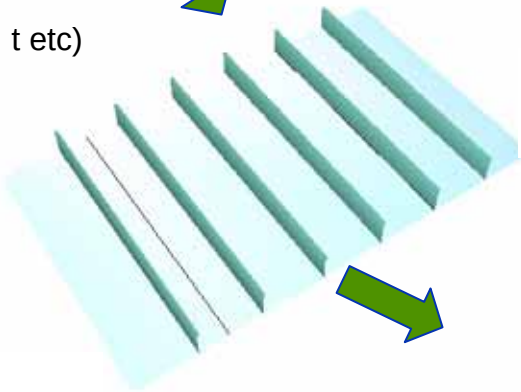
- Automatic buckling and von-Mises stress control of Cargo Hold model:





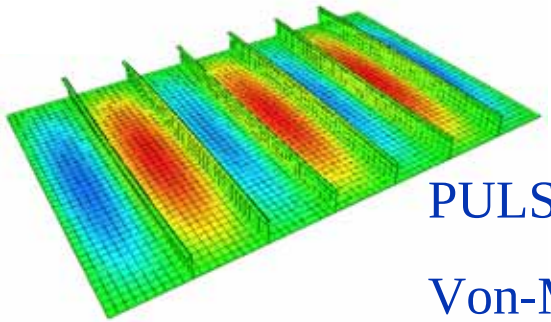
Capacity model

- Geometry (L, B, s, t etc)
- Boundary cond.
- Usage factor
- …..



FEA Results

- Stress
- Pressure



PULS buckling check

Von-Mises stress check

Local fine mesh FE model

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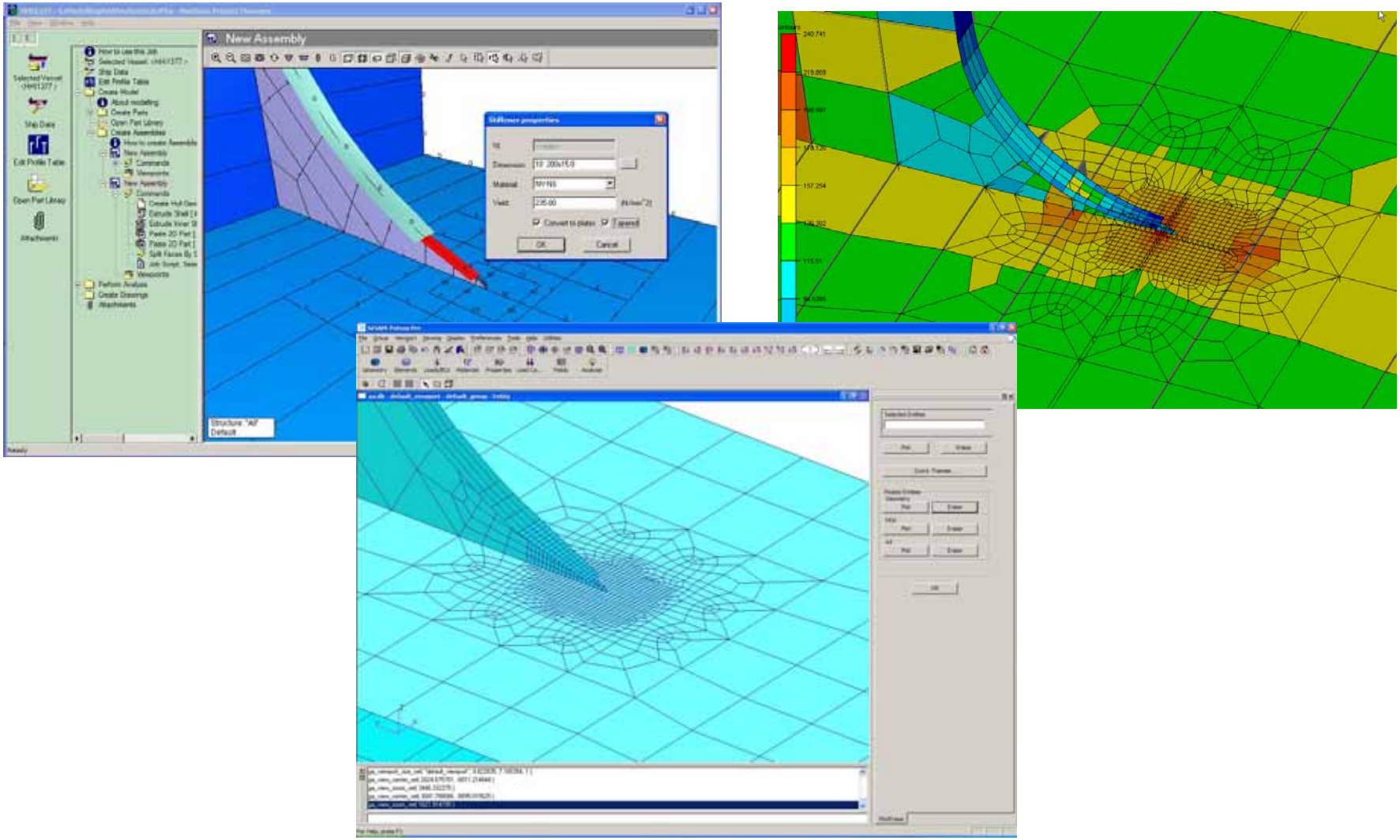

Standardises reporting - Excel

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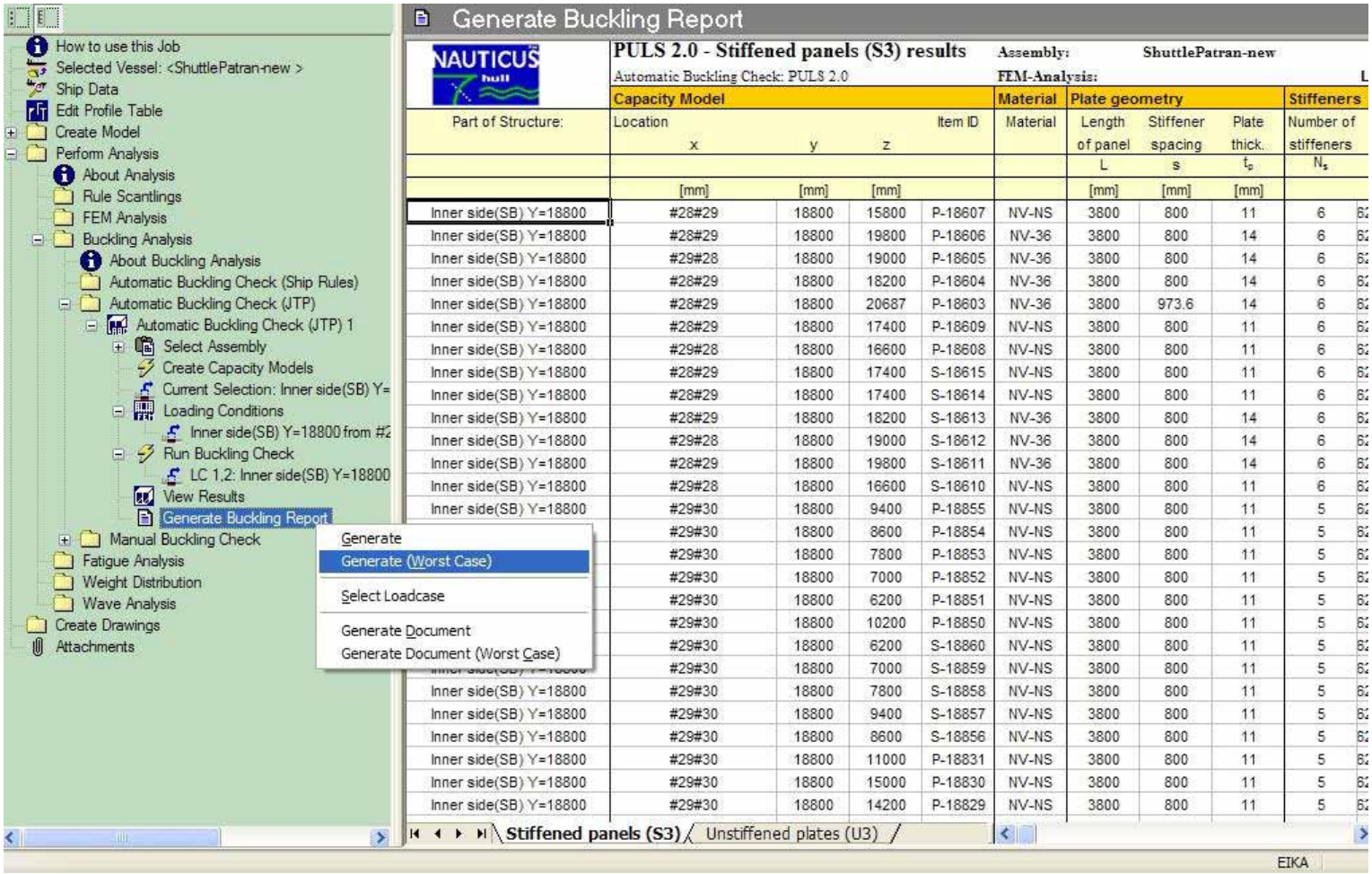

Standardises reporting – ReportViewer

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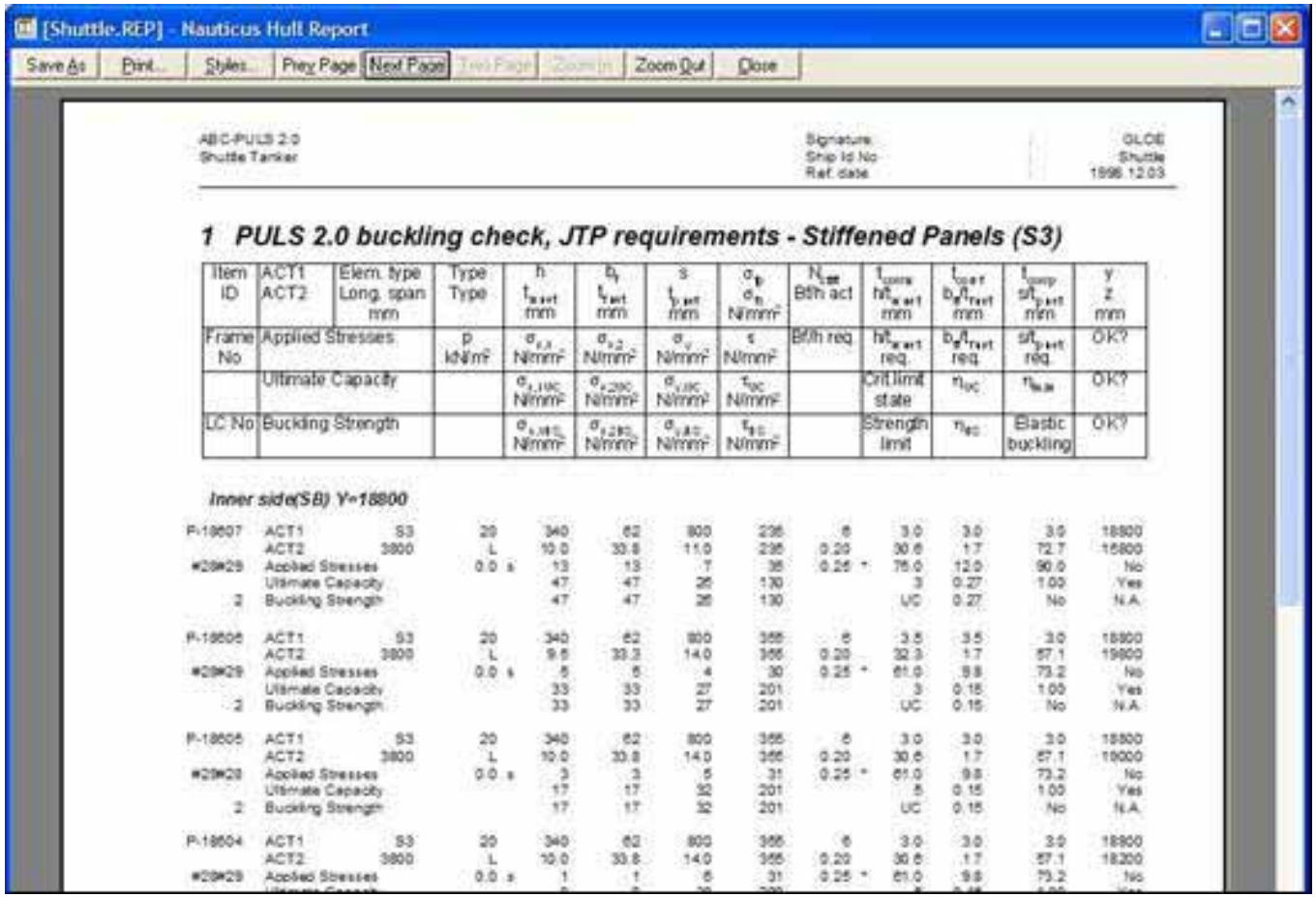

Standardises reporting – GraphicalViewer

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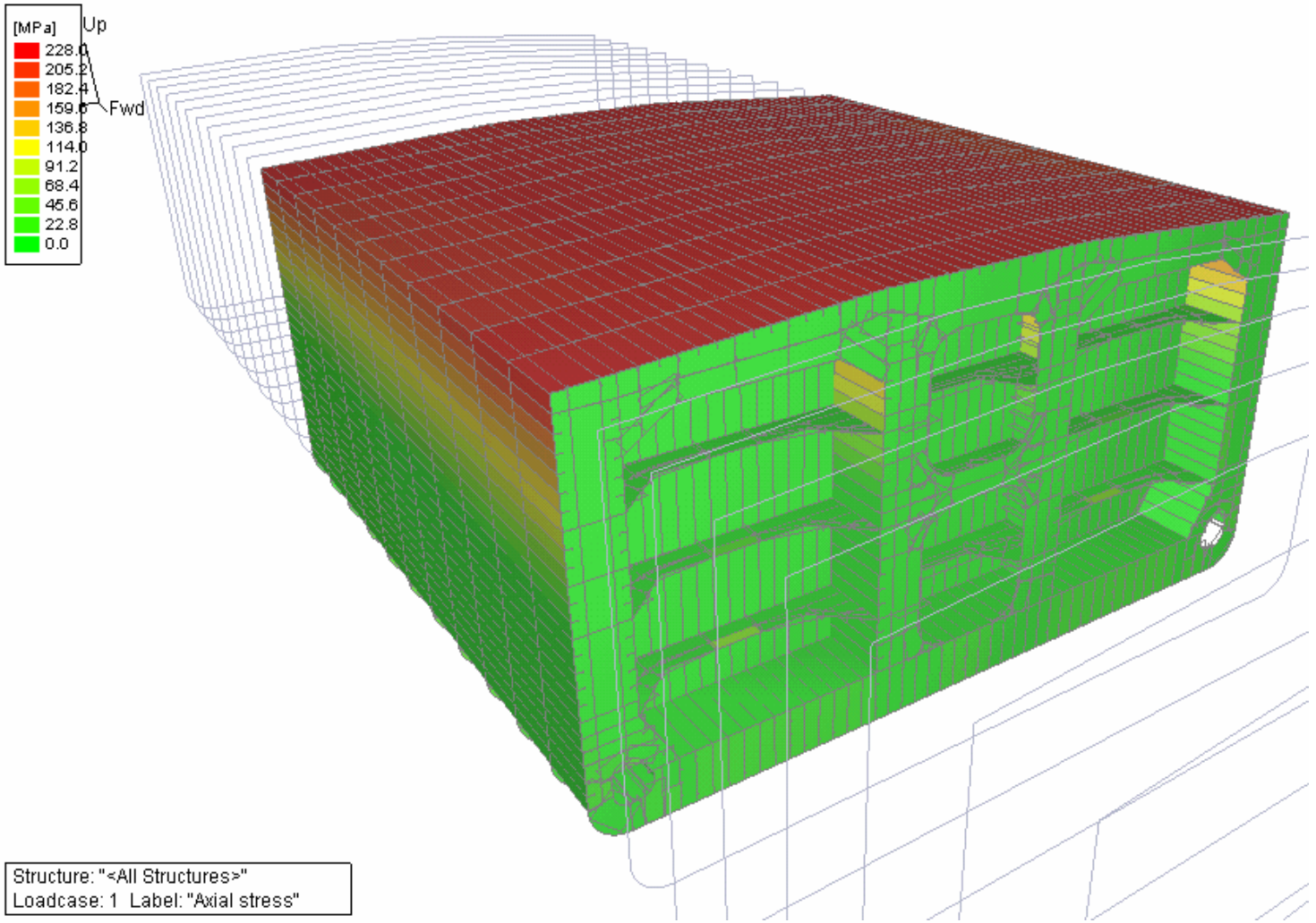

How Nauticus Hull adds value to the CSR Tank Rules

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- Comprehensive:
  - Through Nauticus Hull, DNV deliver extensive software support for the the new Rules (CSR Tank)
- Effective / support design process:
  - The Section Scantlings program fully support optimization and proposing main scantlings based on the CSR Tank requirements.
  - Results are not merely shown as ”OK” or ”not OK” or as utlization factors, instead required scantlings are calculated as an aid to the designer.
  - PULS Advanced Viewer provides easy access to 3D graphics of different results like buckling modes, redistributed stress patterns etc. and provides for a thorough understanding of the physical behavior of non-linear buckling response.

How Nauticus Hull adds value to the CSR Tank Rules

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- Efficient:
  - Not only focusing on cutting modeling and input time, but rather cutting the total design and approval time.
  - Most of the Prescriptive Rules covered by one program, ensuring input only once: Section Scantlings.
  - New tools have been developed to make FE analysis more efficient: automated post-processing and code-checking, as well as generation of loads, net scantlings and boundary conditions.
  - New tools for automated code-checking according to the new method for buckling check, PULS (Panel Ultimate Limit State).
  - Standardised report format ensures easy comparison between Prescriptive Rules and FEA.

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