EXTENDING the life of cyclic duty equipment

Jonathan Cook
Jonathan.c@pttes.com
Warakorn Nuntaya
Warakorn.n@pttes.com

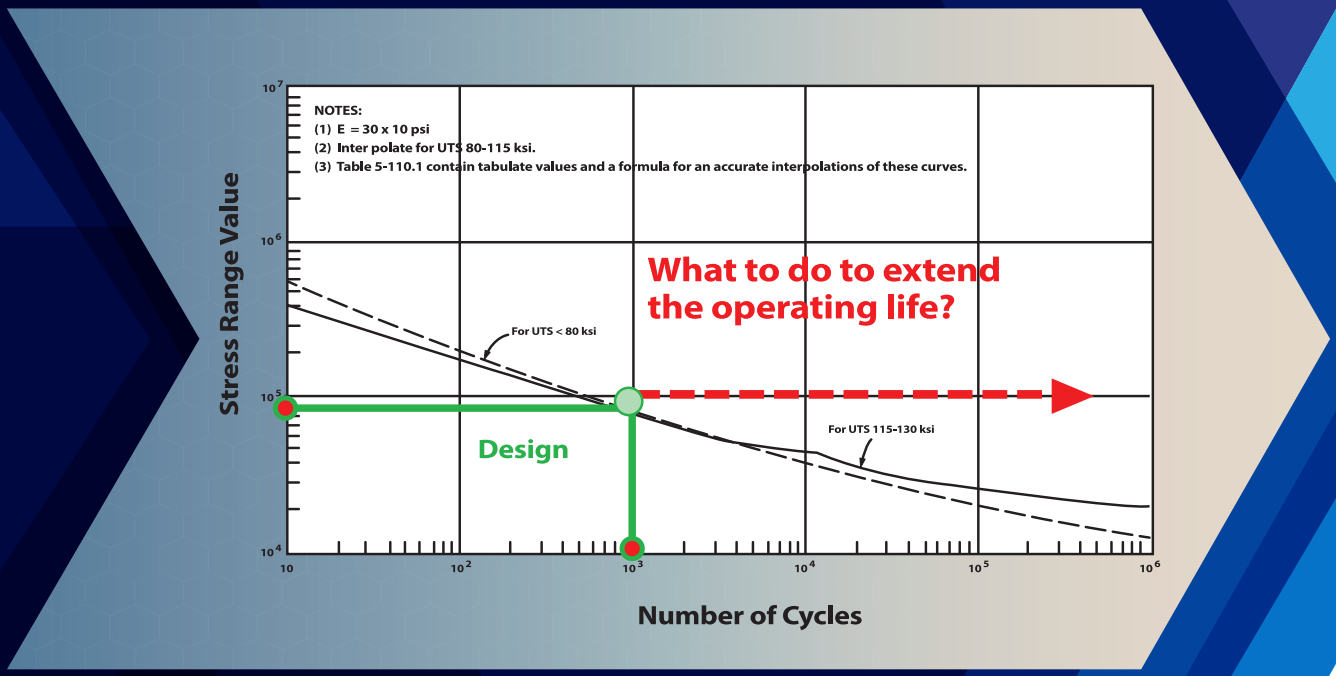
KM Corner

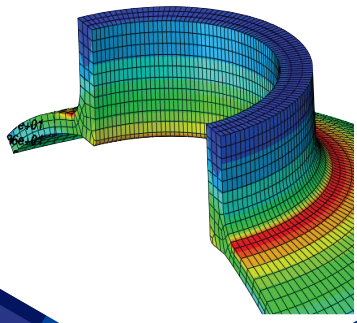
Cyclic Duty Equipment is given a finite life based on a specific number of loading cycles. How do we justify continued operation beyond the design life? What is the ongoing inspection strategy?

Fatigue Design by Rule

- Design codes use Stress-Cycle (S-N) Curves
- Stress levels are limited by design to achieve the required life
- The life is defined in a number of cycles of stress or load.
- The stress to cycle relationship is not linear it is logarithmic – a small reduction in stress leads to a much longer life.

Pressure Swing Adsorbers, Gas Driers, Coke Drums and Auxiliary Boilers are examples of cyclic duty equipment.

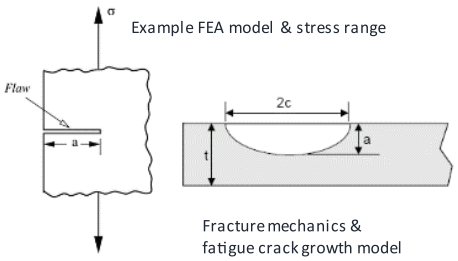




STEP 1:
Identify Equipment Stress Range

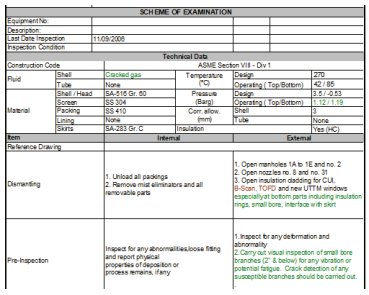
Finite Element Analysis (FEA) is used to determine the stress range in locations such as nozzles, manways, dished ends, skirt connections etc.

KM Corner



STEP 2:
Fitness for Service Assessment

API579 Level 3 Fracture Mechanics calculations to arrive at a critical defect size beyond which the equipment will be at risk of failure. Determination of the cycles for a detectable defect to grow to the critical size



SCHEME OF EXAMINATION

Equipment No:					
Description:					
Last Date Inspection	11/09/2006				
Inspection Condition					
Technical Data					
Construction Code		ASME Section VIII - Div 1			
Fluid	Shell	Cracked gas	Temperature (°C)	Design	270
	Tube	None		Operating (Top/Bottom)	42 / 86
Material	Shell / Head	SA-516 Gr. 60	Pressure (Barg)	Design	3.5 / -0.53
	Screen	SS 304		Operating (Top/Bottom)	1.12 / 1.19
	Packing	SS 410	Corr. allow. (mm)	Shell	3
	Lining	None		Tube	None
	Skirts	SA-283 Gr. C	Insulation		Yes (HC)
Item		Internal		External	
Reference Drawing					
Dismantling		1. Unload all packings 2. Remove mist eliminators and all removable parts		1. Open manholes 1A to 1E and no. 2 2. Open nozzles no. 8 and no. 31 3. Open insulation cladding for CUI. B-Scan, TOFD and new UTTM windows especially at bottom parts including insulation rings, small bore, interface with skirt	
Pre-Inspection		Inspect for any abnormalities/loose fitting and report physical properties of deposition or process remains, if any		1.Inspect for any deformation and abnormality 2.Carry out visual inspection of small bore branches (2" & below) for any vibration or potential fatigue. Crack detection of any susceptible branches should be carried out.	

STEP 3:
Specify future inspection tasks and frequency

Specify inspecton tasks and frequency to locate potential defects in the equipment. Use advanced NDT to allow in-service inspection externally. Move to a Non-intrusive inspections scheme - no confined space entry. Frequency of inspection increased by 2x

Project Benefits

- ✓ No need for replacement equipment
- ✓ Continued safe & reliable operation
- ✓ Reduced costs & efficient use of inspection resources
- ✓ Risks of confined space vessel entry removed
- ✓ Local knowledge transfer to the client

Update inspection tasks and extend frequency using a Focused Scheme Of Examination (FSOE)