44TH TURBOMACHINERY & 31ST PUMP SYMPOSIA
HOUSTON, TEXAS | SEPTEMBER 14 – 17 2015
GEORGE R. BROWN CONVENTION CENTER

CENTRIFUGAL COMPRESSORS 101

Mark J. Kuzdzal
Director, Supersonic Compression Technology
Dresser-Rand Company

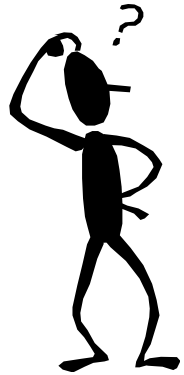
Jay Koch
Principal Engineering Leader for LNG
Dresser-Rand Company

September 14, 2015

TEES TURBOMACHINERY LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION

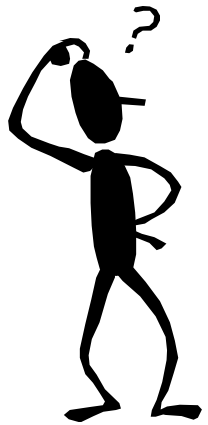
TEXAS A&M UNIVERSITY

Who Are We???



- **Mark J. Kuzdzal**
- **1988 Graduate of University of Buffalo (BSME)**
- **Joined Dresser-Rand in 1988**
- **Texas A&M Advisory Committee Member Since 2004**
- **Penn State Advisory Committee Member Since 2004**
- **RotorDynamics group, NPD team, Datum Development Team, Development Manager, Core Tech. Manager, Business Development Director.**
- **Current Responsibilities include:**
  - **Supersonic compressor product line definition and commercialization.**
  - **Favorite work-related topics: aero-mechanical excitation (SSV), & Acoustics**

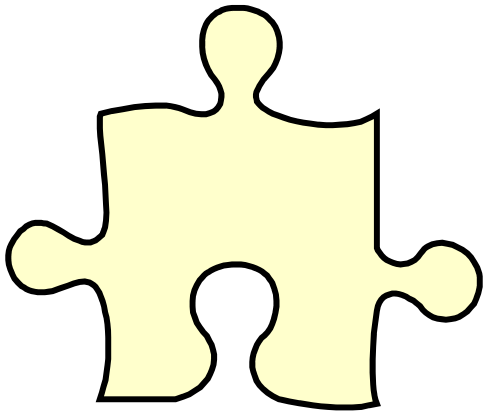
Who Are We???



- **Jay Koch**
- **Graduate of Iowa State University (BS Aerospace Eng.)**
- **Joined Dresser-Rand in 1991**
- **Worked for Allied Signal Aerospace before joining D-R**
- **Aero Dynamics group, NPD team, Datum Development Team, Manager Aero/Thermo Design Engineering, R & D Manager, Principal Engineering Lead – LNG**
- **Responsibilities include:**
  - **Design, development, and analysis of all aero dynamic components of centrifugal compressors**
  - **Development of software used to select and predict compressor performance.**
  - **Improved aero dynamics efficiency and range.**
  - **New Product Development**

Agenda

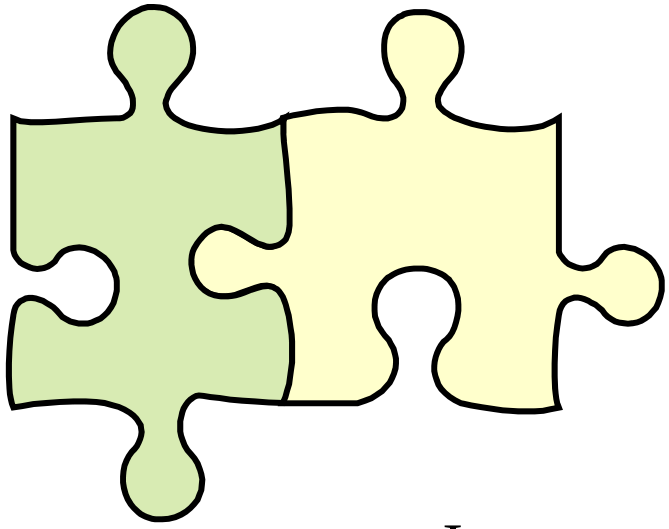
- Reciprocating and centrifugal compressor similarities/ differences
- How do they work? (Potential Energy, Kinetic Energy, PE, KE, …)
- History of compressors
  - Timeline, major advances
  - Configurations, straight-through, back-to-back, compound, side streams, double-flow
- Markets served
- Pressure containment
  - Case
  - Nozzles and flanges



Mark

Agenda Continued

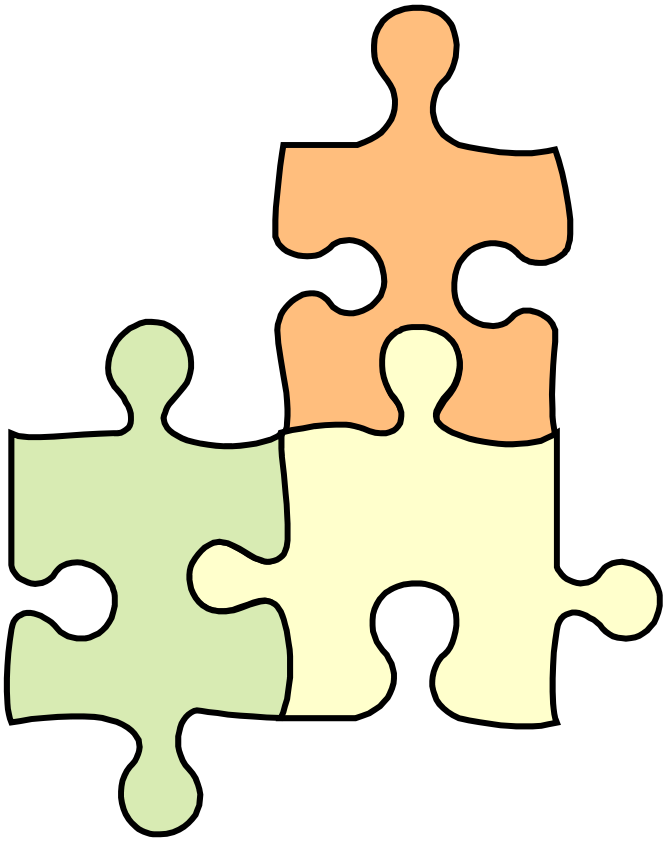
- Selection Process
  - Aerodynamic Selection
  - Mechanical Design
  - Rotordynamic Design
- Impellers
  - Design Basics
- Stationary Aero Components
  - Inlet, inlet guide
  - Diffuser, vaned and vaneless, LSD
  - Volute and collector
  - Return bend / Return channel
- Compressor Performance
  - Nomenclature
  - Impact of Operating Conditions
  - Internal Leakage
  - Surge Control



Jay

Agenda Continued

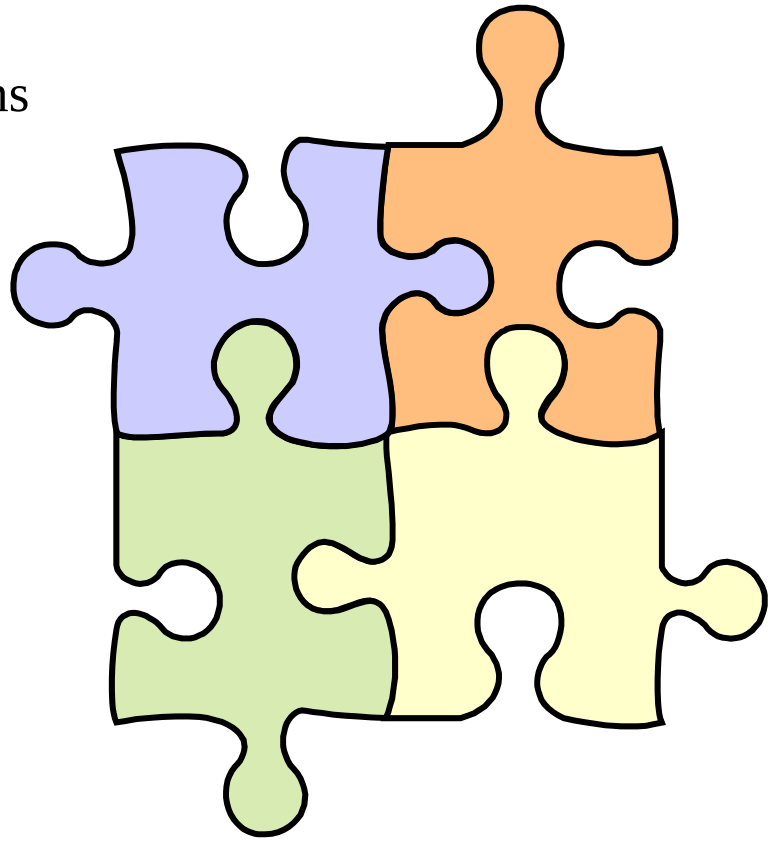
- Rotordynamics
  - Critical speed maps
  - Synchronous unbalance response
  - Stability, log decrement
  - Damper seals
  - Bearings, seals
  - TP, Sleeve, magnetic
  - Squeeze film damper
  - Steady state and transient torsional
- Stress analysis
  - Impeller dynamics
- Acoustics
- Seals
  - Gas seals
  - Oil film seals
  - Laby



Mark

Agenda Continued

- Testing
  - Type 2 and Type 1, Performance testing
  - Mechanical testing
- Vibration signatures of classic problems
  - Rotor Instability
  - Surge and stall - forced vibration
- Materials considerations
  - NACE
  - Typical compressor materials
  - Effects of blockage and fouling
- Adjourn



Jay