SHIFTING THE PARADIGM FOR THE DESIGN OF NEW REMOTE LABORATORIES

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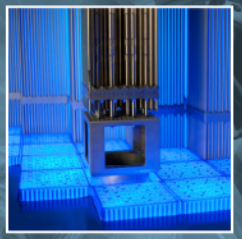

NUCLEAR SERVICES & TECHNOLOGY

September 23, 2013

- In the beginning….

Looking Forward

- But now we have 60+ years of lessons learned, technology has advanced. What is the design approach being used to design cells that will be used for the next 50 years?

The Issue

- 50 years of experience has shown that routine manipulator use can cause repetitive stress injuries.
- Special conditioning and exercise programs.

In other words, the technical approach is not to fix the technology, but to build a better operator.

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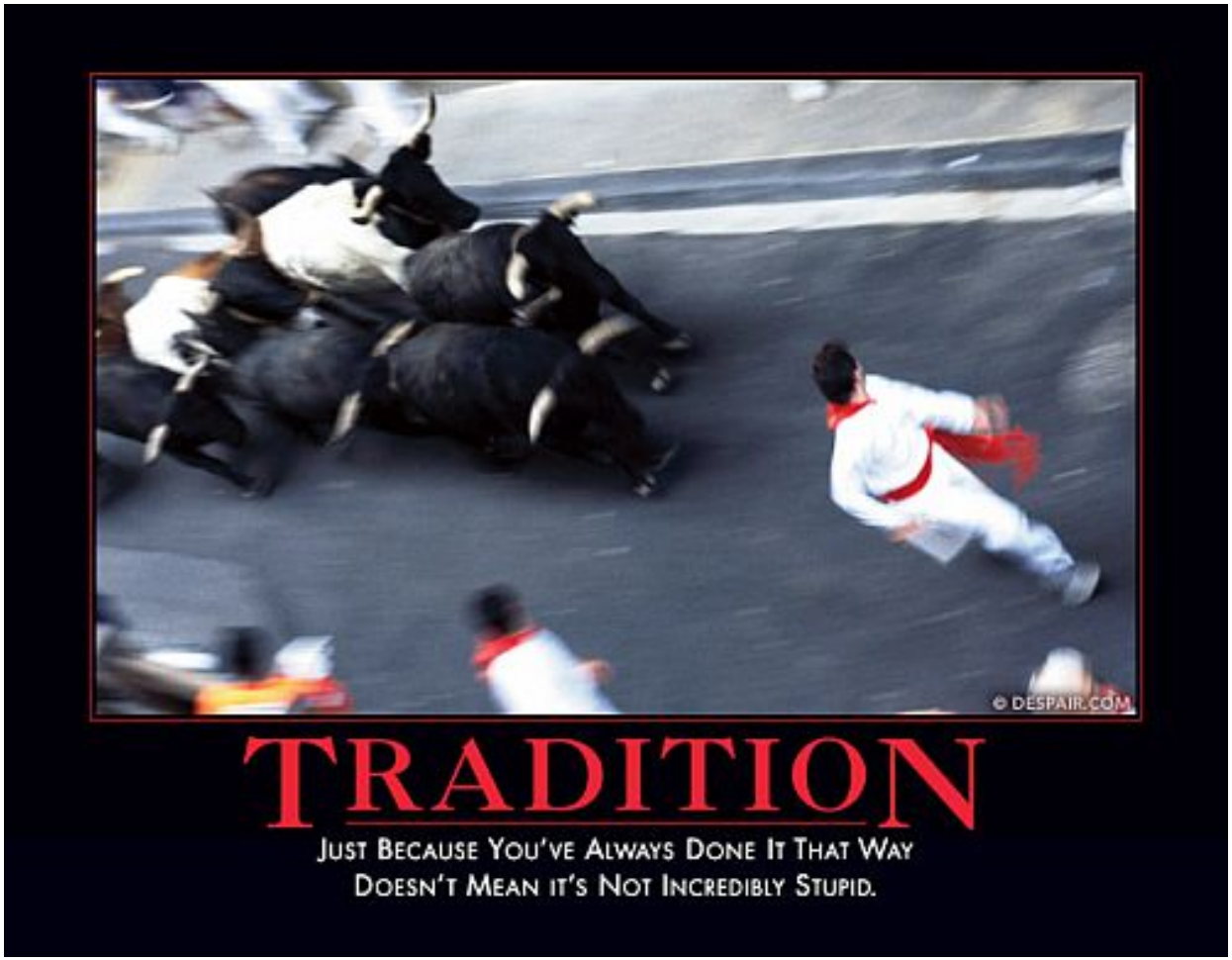
Why not focus on technology?

- Possible Explanation #1:

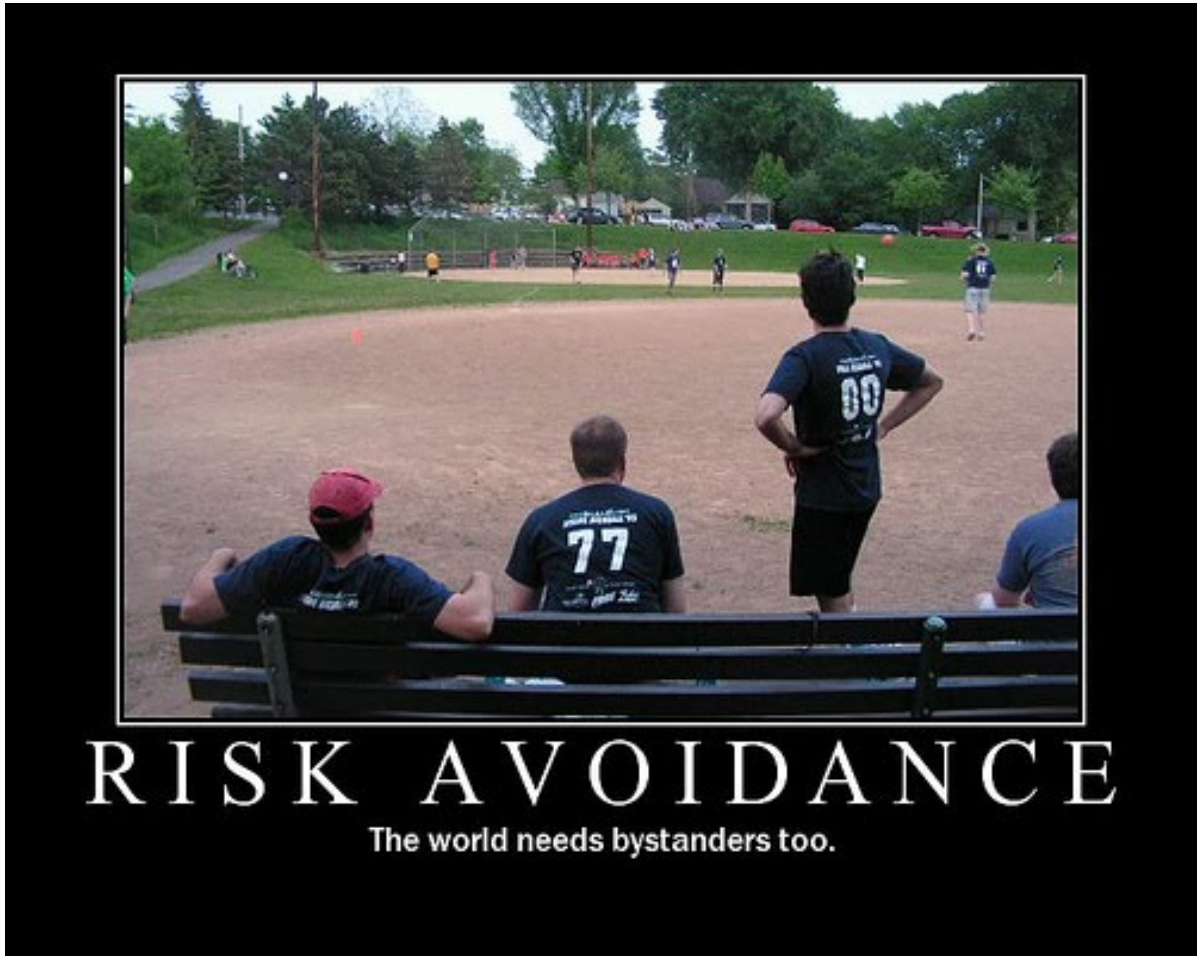
"If it's not broke, don't fix it."



Why not focus on technology?

- Possible Explanation #2:

Risk Avoidance



Why not focus on technology?

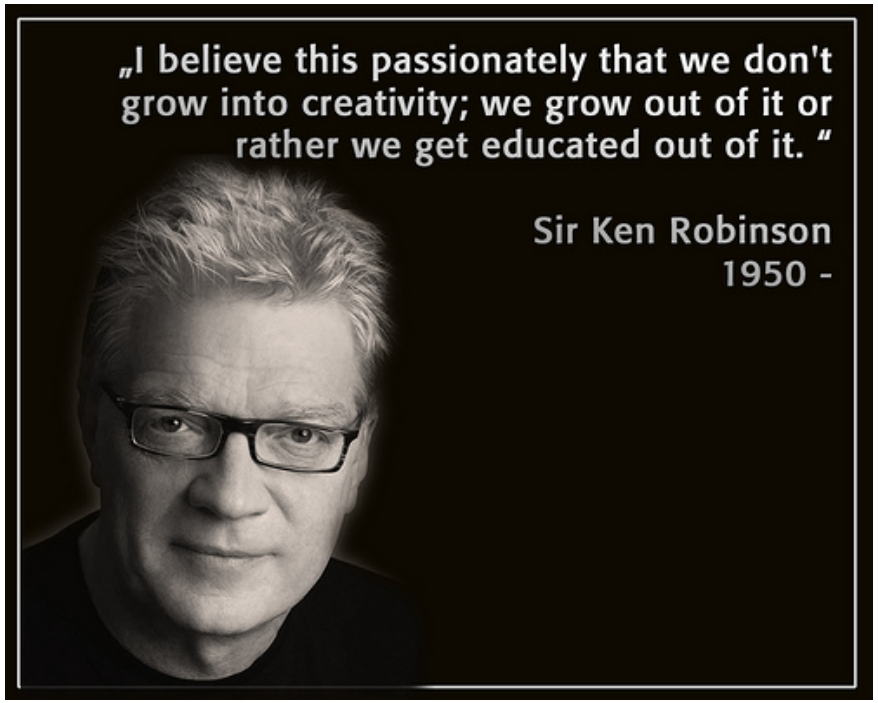
- Possible Explanation #3:

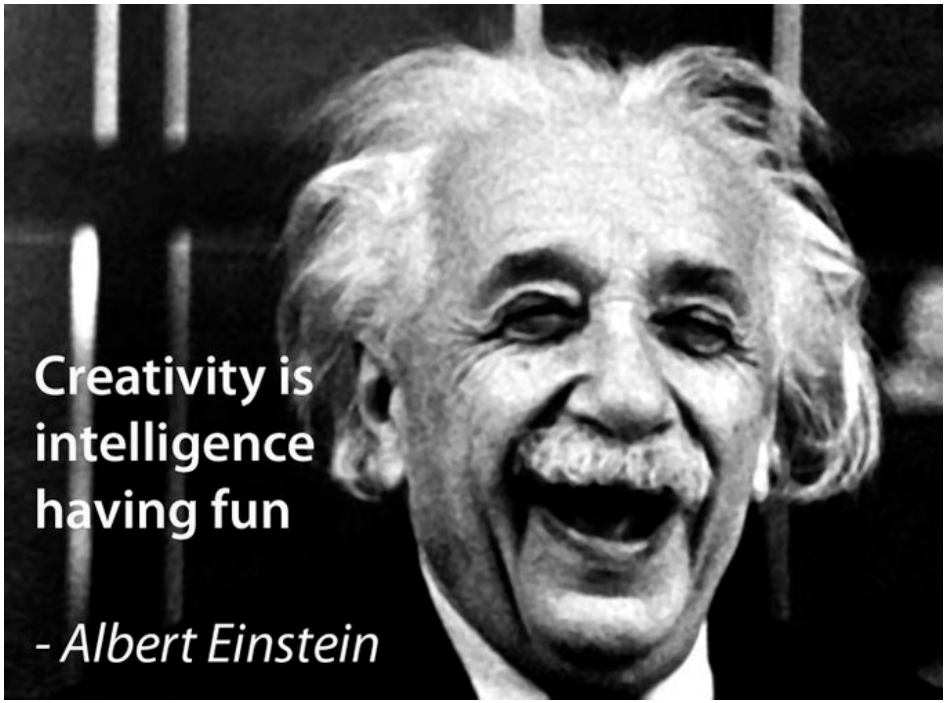
Cost Reduction

Capital Costs vs Life Cycle Costs

Why not focus on technology?

- OR as engineers and scientists have we been intellectually lazy and lacking in creativity?





Hot Cell Design Goals

Design Consideration	Design Goals
Radiation	Dose Rate Target
Visibility	Provide the most realistic, first person perspective of the work being performed to the operator.
Ventilation	Minimize release air volume while maintaining cleanliness requirements.
Operator Interface	Remote manipulator designs that are more accommodating of the anthropometric differences between operators. Reduce physical demands to reduce/eliminate physiological issues that currently plague today's operators. Enhanced visibility to effectively increase cell size and eliminate constraints that drive equipment locations within the hot cell. Increase operator precision/efficiency.
Future Compatibility	Penetration number and capacity. Cell Size. Improve Remote Handling Kinematics (additional degrees of freedom). Structural qualification to accommodate modified equipment loads.

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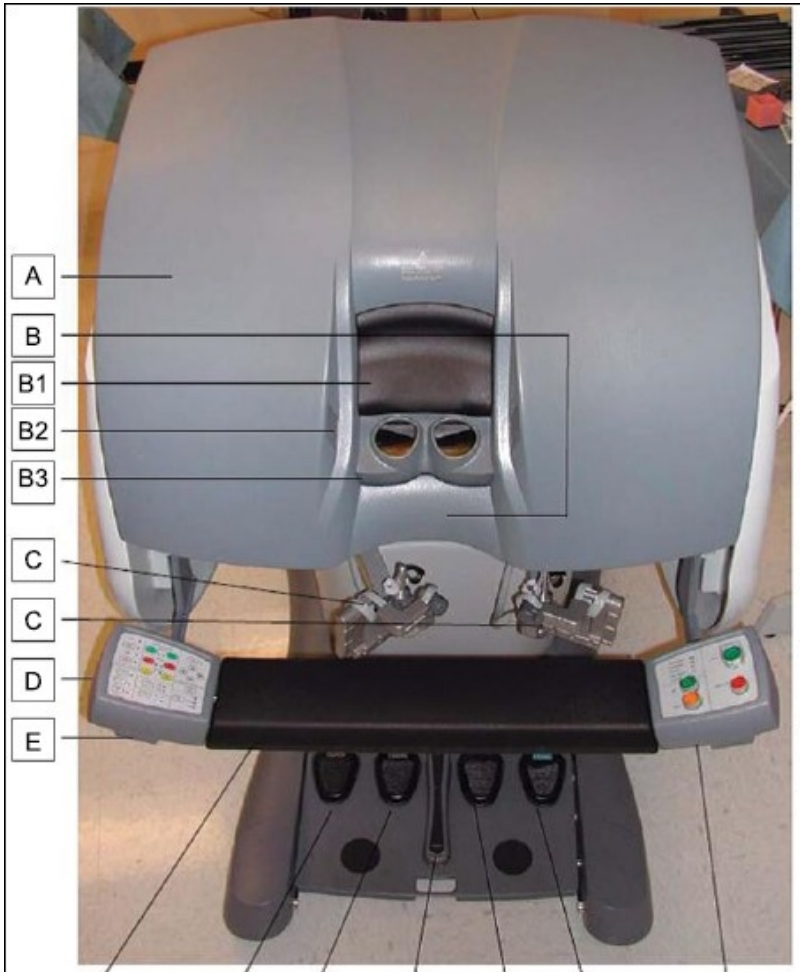
- 7 of 11 criteria relate directly to the operator.
- 6 of those directly to the man/machine interface.

The Paradigm Shift

- Let's fix the technology!
  - 10,000 years of evolution suggest that we are not going to make much progress on building the better operator.
  - It's difficult to believe that 60 years ago they got the perfect answer on the first try.
  - Another model already exists that:
    - ☺Improves the efficiency and accuracy of the user.
    - ☺Would eliminate the need for expensive shield windows.
    - ☺Offers improved visibility with accurate color rendition.
    - ☺Reduces in-cell lighting requirements.
    - ☺Would be easily upgradeable in the future.
    - ☺Ergonomically superior to existing technology.

The da Vinci

The da Vinci – Surgical Console



Legend

A. Surgeon Console Shell

B. View Port

- B1. Head Rest
- B2. Infrared Sensor
- B3. Stereo Viewer

C. Master

D. Viewer Height Controls

E. User Interface Panel

F. Armrest

G. Foot Switch Assembly

- G1. CLUTCH
- G2. CAMERA CONTROL
- G3. +/- (Camera Focus)
- (G4. UNUSED)
- C5. COAG

H. User Switch Panel

The daVinci – Remote Console

- 4 tele-operated arms
- Stereo Vision with adjustable Magnification.
- Motion Scaling (Surgical Console)

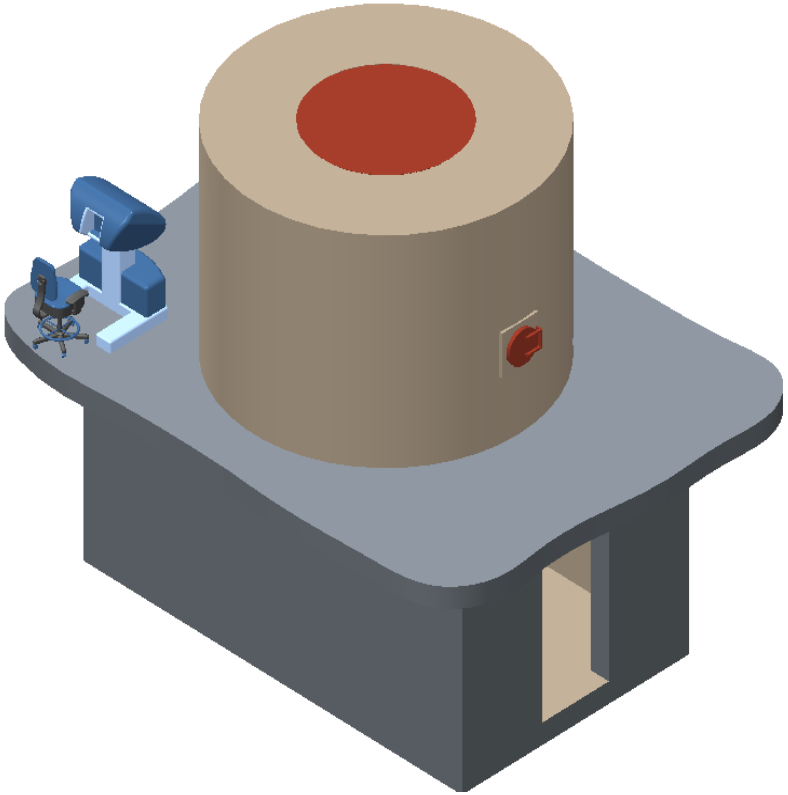
Capabilities

4

da Vinci Surgery on a Grape

Translation

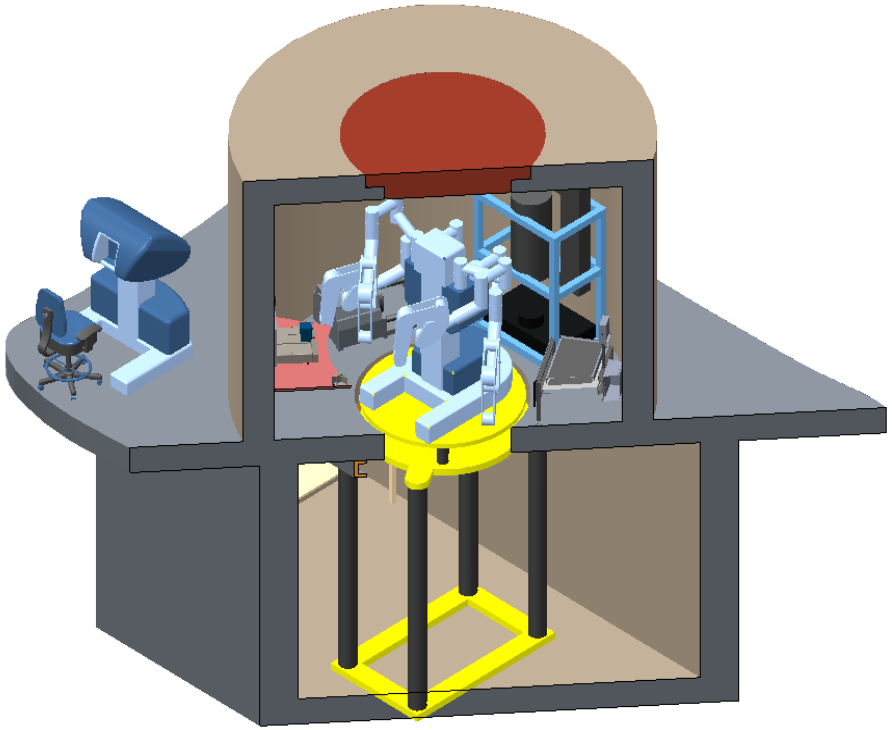
- Potential Cell Configuration



- Round-Maximum Cell Volume
  - Minimum Shielding Volume
    - Tele-operation provides opportunity for additional shield thickness reduction

Translation

- Rotating, Elevation Controlled, Remote Console Platform
  - Infinite Approach Angles
  - Allows more compact equipment placement.
- No shield windows.
- Tele-presence
  - Additional views could be provided.
- 4 arms, 1 interface
- Both operator and remote consoles easily upgradeable.

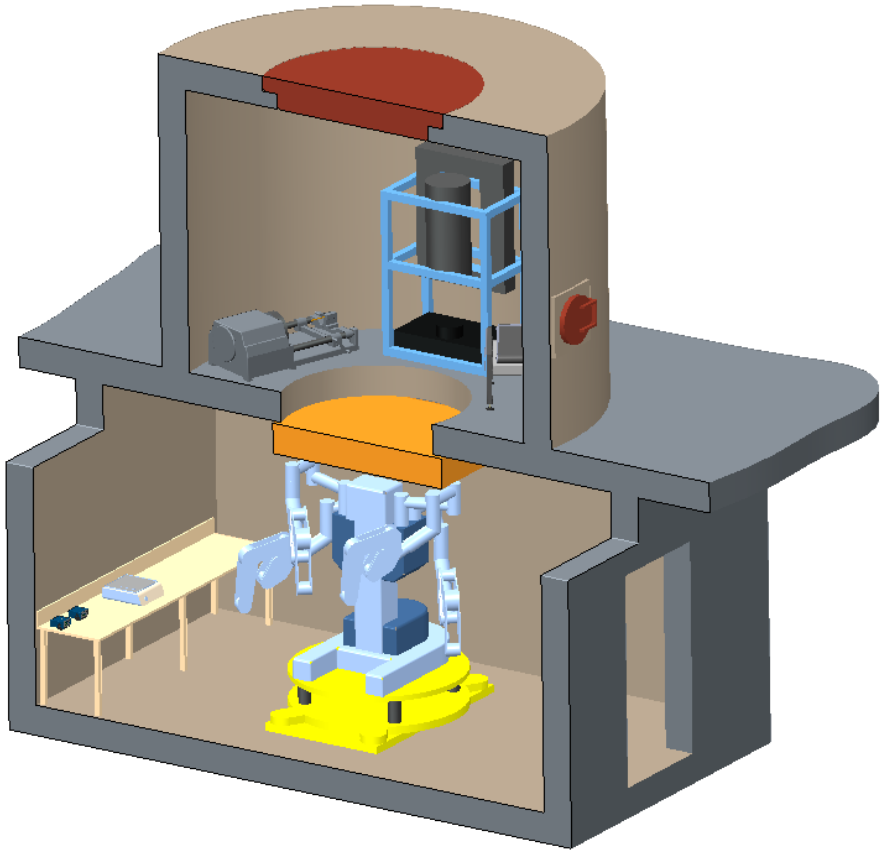


Translation

- The operator interface would be uniform between hot cells, and yet customizable between operators.

- Could provide a cost effective method of executing the replaceable confinement design concept.

- For process driven cell configurations, single remote console could service multiple cells.



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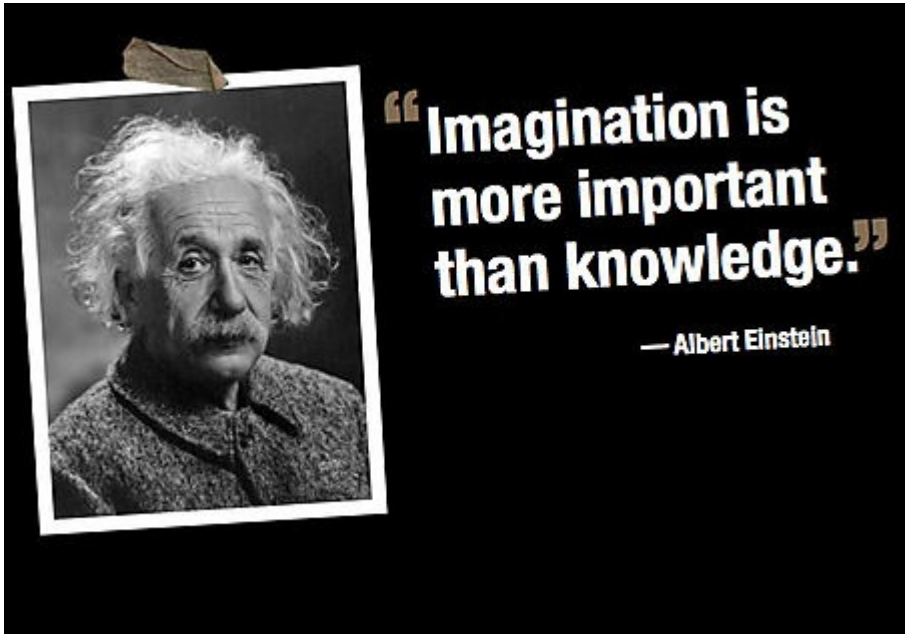
Conclusion

- Concept shown is not the final answer.
- Potential to vastly improve the life of operators.
  - Ergonomics
  - Absorbed Dose
- Demonstrated in a demanding industry to improve operator efficiency and accuracy.
- Potential to reduce capital costs, as well as life cycle costs depending on configuration.
- Provides significant opportunity for upgrades, and cell modification without having to replace the cell.

- QUESTIONS?


"Imagination is more important than knowledge."
— Albert Einstein