Integrated Operations for Nuclear

LWRS LIGHT WATER REACTOR SUSTAINABILITY

Demonstration of Advanced Training Supported by STP

December 2, 2024

Idaho National Laboratory

Industry Landscape

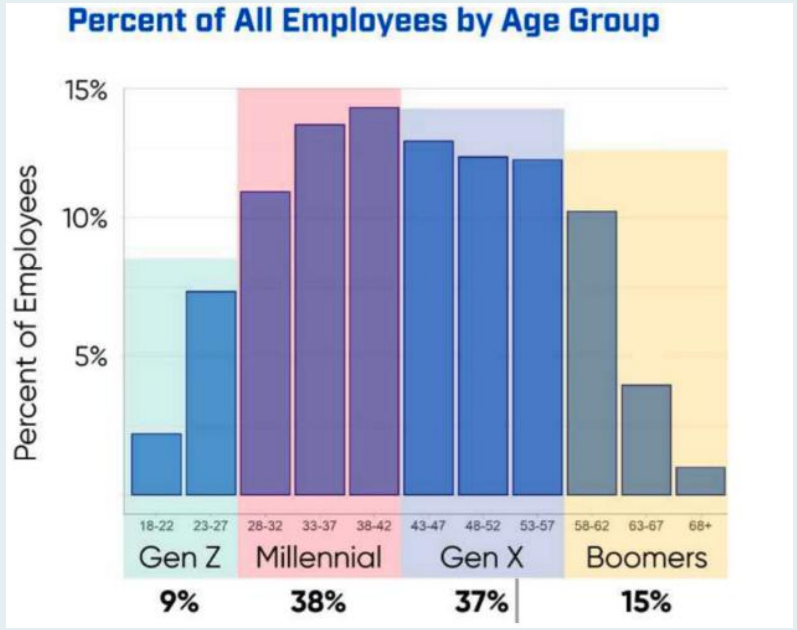
Recently, the nuclear power industry has been facing challenges relating to:

Cost Pressures

Learning Methodologies

Energy Industry Workforce Trends

CEWD 2023 Energy Workforce Survey Results



How can we most effectively transfer the knowledge of Baby Boomers & Gen X to Gen Z?

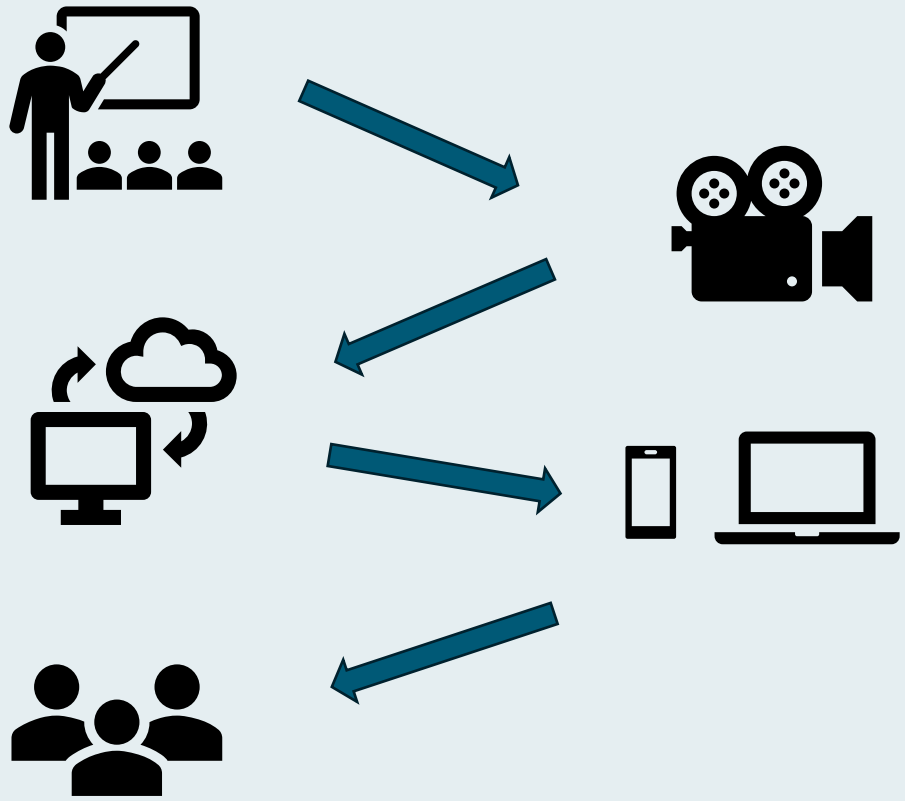
Background

Problems in Nuclear Training:

- Demographic shift due to retiring workforce increases pressure on knowledge transfer
- Cost cutting has reduced resources per learner without making the learning process more efficient
- GoPro video tutorials have been attempted but have failed to be implemented at scale and/or are of unusable quality
- VR/AR technologies do not **yet** have a compelling business case for improving nuclear training
- Classroom training is resource intensive

Past Advanced Training Research:

- INL *Advanced Training Research* has confirmed a strong business case for modernizing training methods, and learners will benefit from an accessible knowledge base and digitized training resources
- INPO's *Proficiency (24-001)* guidelines encourage organizational leaders to embrace innovation in training technology to increase individual proficiency, which will especially benefit inexperienced workers in training



Past Research on Application of Advanced Training Technology

Work Reduction Opportunity in Detail

Advanced Training Technology[1]

Xcel Energy
(Verification Partner)

FTE Savings

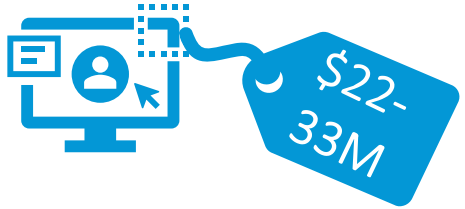
7-9 Operations Training

9-13 Technical and General Training

0-2 Training Records

16-24 Harvestable FTE resources

Investment

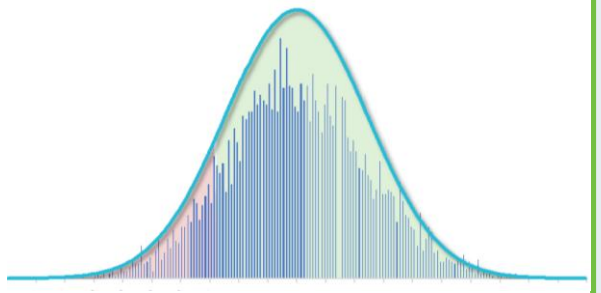


Initial Cost for digital simulator, training modules, software, digital documents, and VR/AR hardware

$170k - $360k per year

Ongoing Costs

Business Case



Probability of achieving a positive net present value

87%

$3.4M ± 340k estimated harvestable annual cost savings by implementing Advanced Training Technology WRO

1. Based on analysis conducted and reported in INL/RPT-22-68671

Objectives of the Project

Convert Accredited Training Course PowerPoint into Advanced Training Format

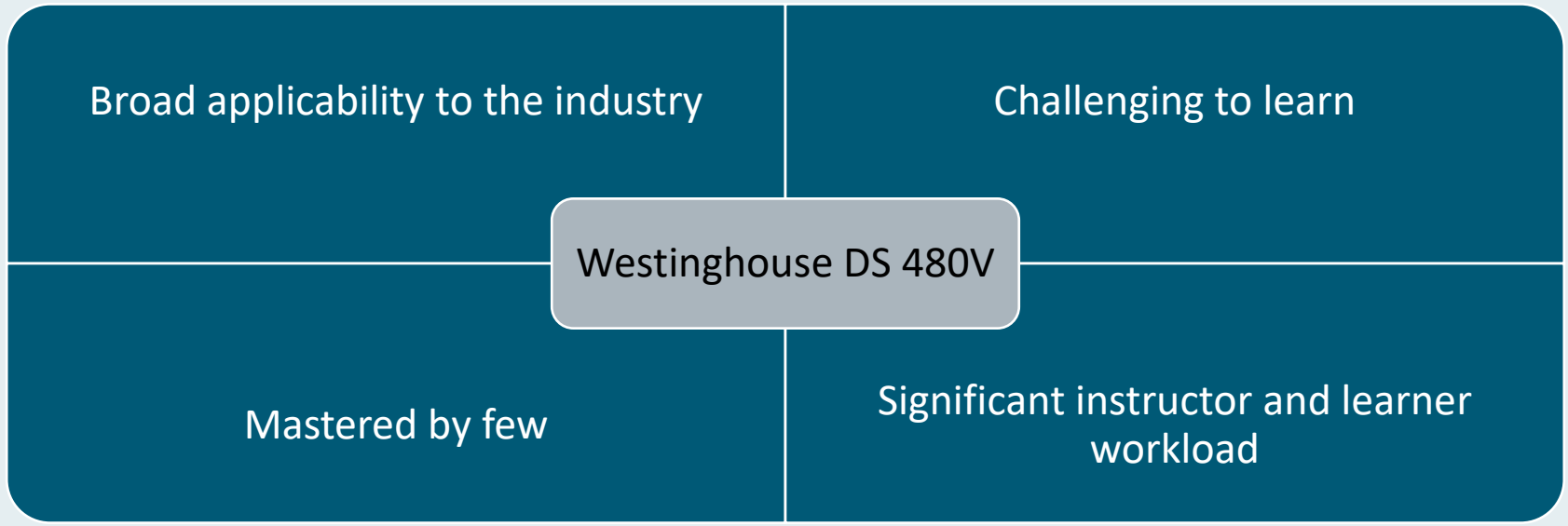
Identify Benefits for Instructors and Leaners for topic selected

Identify Constraints and Risks

Estimate Benefits of Scaling Advanced Training to other topics and/or across industry

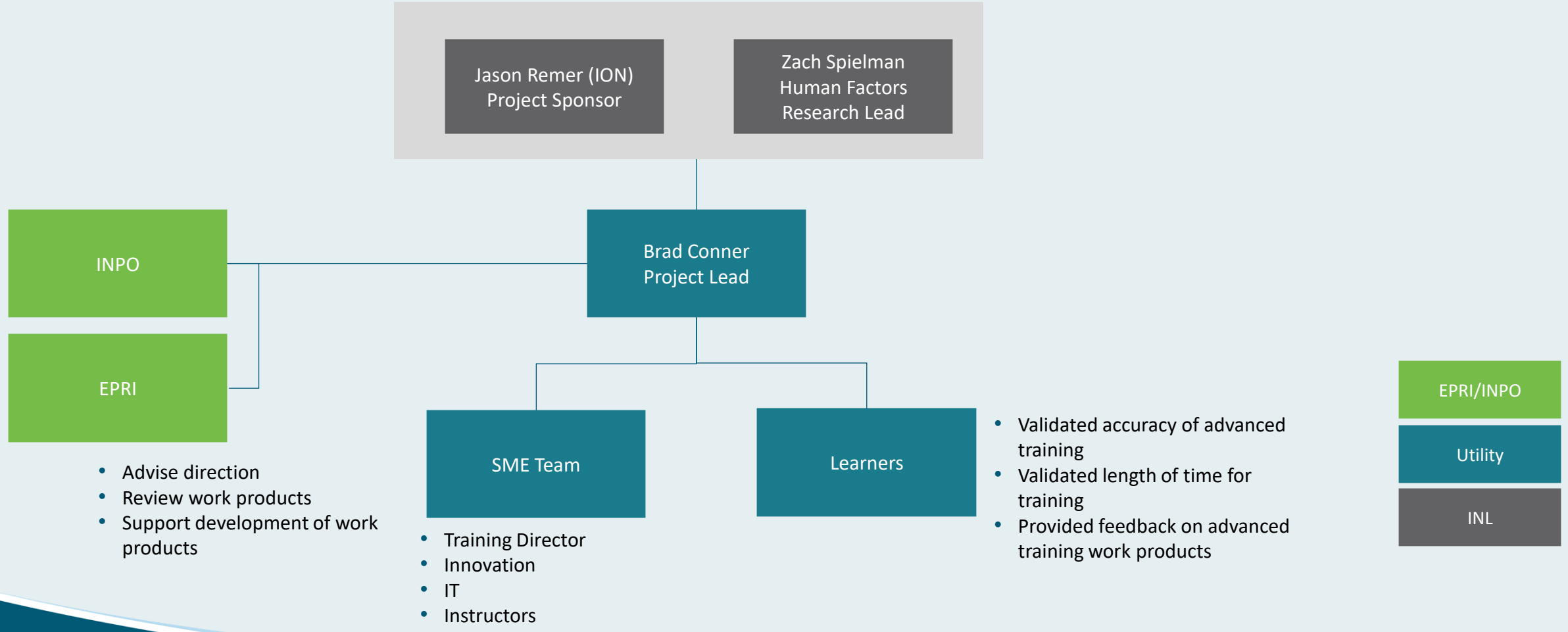
Approach

What is the best training course to highlight the benefits of a modernized CBT? The project team decided on the following **criteria**:



The general overview initial training class for the **Westinghouse DS 480V circuit breaker** was chosen, as it is **representative** of the average class and therefore would help estimate the total workload reduction of converting all courses in the curriculum.

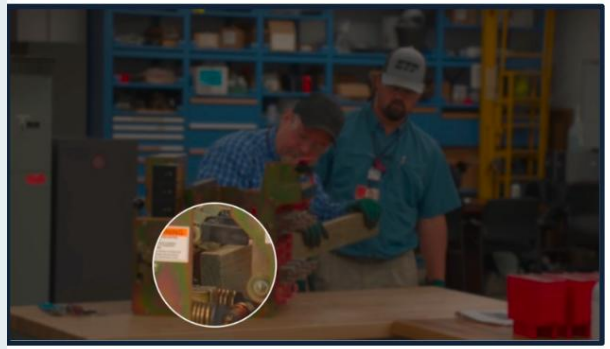
Team Participants

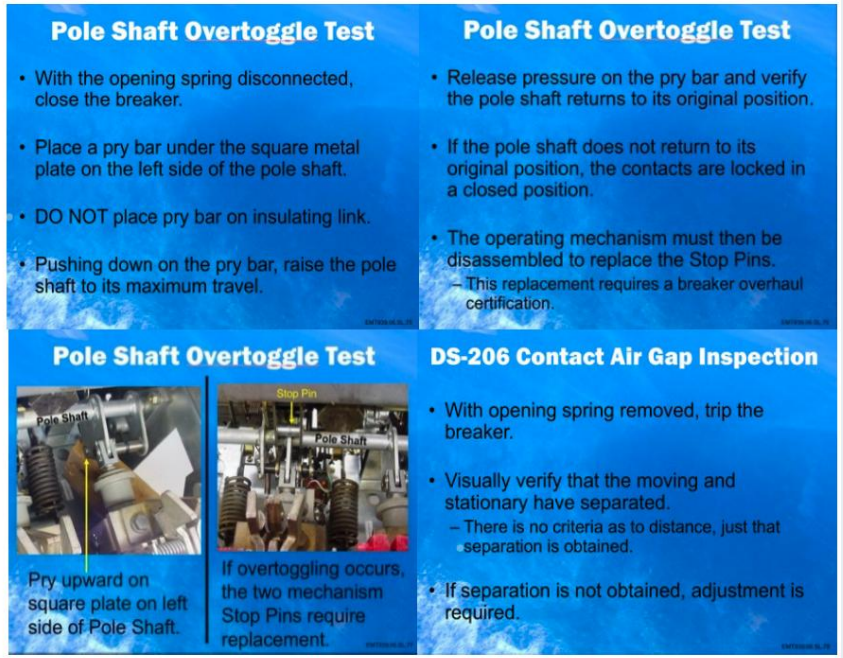


Work Product Feature Examples

This example shows screenshots of the Video tutorial for the overtoggle test on the left and the current accredited PowerPoint slides on the right. Key features of the modernized CBT are shown, such as:

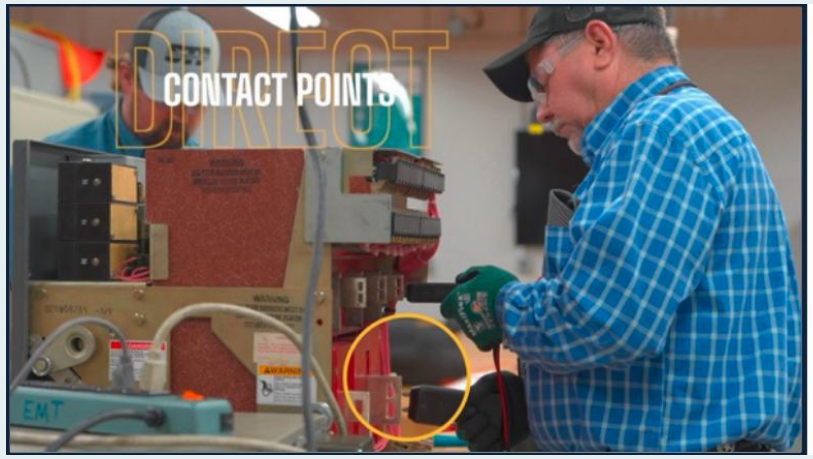
- **Magnification**
- **Different Camera Angles**
- **Visual Cues**

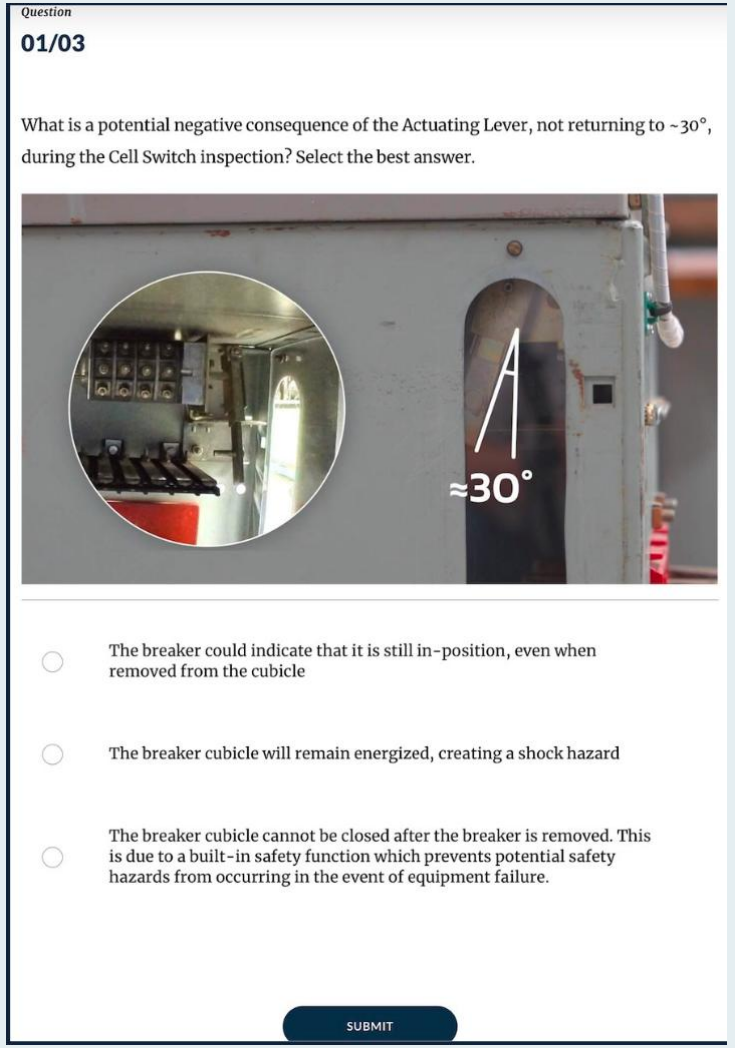




Work Product Feature Examples

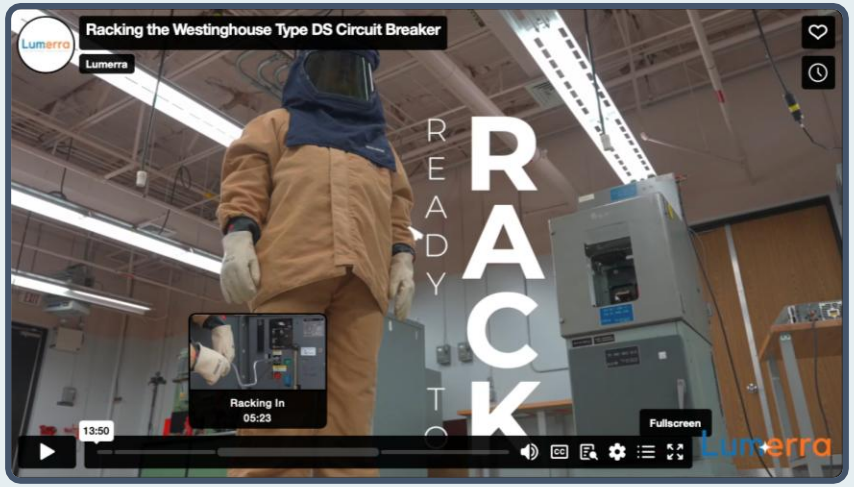
These examples shows screenshots of the **visual aids** used in the advanced training work products below and shows a **behavioral question** from the modernized CBT to the right.

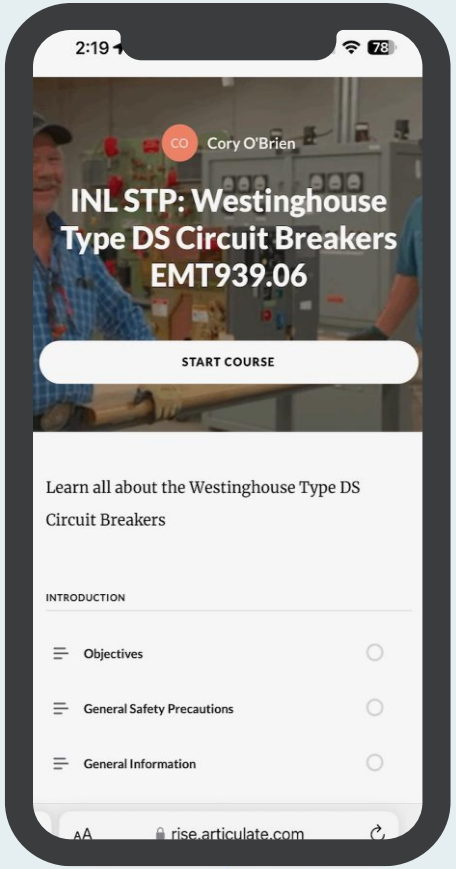




Work Product Feature Examples

These examples show a GIF of the **detailed technique** conveyed in the CBT, as well as a screenshot showing the **chaptered organization** video tutorials. On the right is a view of how the modernized CBT works on a smartphone, and the modernized CBT works on any smartphone or laptop and adjusts the scale for perfect UX.





Comparing Classroom Training to Modernized CBT

Current state of chosen training course:

The initial maintenance class in this project currently has a duration of 10 hours in a classroom and is held once every 3 years. Each instructor teaches 8 learners using a PowerPoint presentation, with which the learners study and memorize the class content.

Future state using the modernized CBT:

- Took learners between **65-75** minutes to complete modernized CBT
- Classroom Delivery Duration(10h) / modernized CBT Duration(1.25h) = **8:1**
- Learners reported **improved understanding** after completing the modernized CBT
- Instructors reported modernized CBT was effective for **knowledge transfer**
- Support was expressed **for replacing low-value class time** with modernized CBT
- Instructors reported CBT was often **more engaging and detailed** than classroom instruction
- Neither learners nor instructors saw issues with the CBT as **supplemental content**, and it had no drawbacks for learner understanding

Potential Benefits of Applying Advanced Training to Other Initial Maintenance Training Courses

Current Hours

Electrical(29 Courses)	
Instructor hours	300
Learner hours	2400

I&C(22 Courses)	
Instructor hours	180
Learner hours	1440

Mechanical(15 Courses)	
Instructor hours	72
Learner hours	576

General Maintenance(4 Courses)	
Instructor hours	35
Learner hours	280

Annual Totals (current)	
Instructor hours	**587**
Learner hours	**4696**

ANNUAL WORKLOAD SAVINGS:
Instructor: 512
Learners: 4,114

Future Hours

Electrical(29 Courses)	
Instructor hours	38
Learner hours	300

I&C(22 Courses)	
Instructor hours	23
Learner hours	175

Mechanical(15 Courses)	
Instructor hours	9
Learner hours	72

General Maintenance(4 Courses)	
Instructor hours	5
Learner hours	35

Annual Totals (future)	
Instructor hours	**75**
Learner hours	**582**

Analysis of Workload Reduction Potential Across Industry

Scaling workload reduction opportunities to the nuclear power industry

To understand how sharing modernized CBTs could benefit the entire nuclear power industry, imagine a scenario where every NPP in the United States uses a Westinghouse DS 480V circuit breaker and teaches the same class as the reference plant.

Reference Plant Annual Hours (Westinghouse DS 480V classroom course only)	
Instructor hours	3.3
Learner hours	26.6

All 54 US Plants Annual Hours (Westinghouse DS 480V classroom course only)	
Instructor hours	178.2
Learner hours	1436.4

Developing Advanced Training (~400hrs) at One Plant

Reference Plant Annual Hours (Westinghouse DS 480V Modernized CBT course only)	
Instructor hours	< .5
Learner hours	3.3

All 54 US Plants Annual Hours (Westinghouse DS 480V Modernized CBT course only)	
Instructor hours	22.3
Learner hours	179.6

An advanced training module can be developed **once** but can be distributed **unlimitedly** and requires virtually no workload after created. This example only covers the hourly reduction for a singular type of course, but if this process became widespread for most courses at all plants, the nuclear power industry would jointly reap the benefits from the reduced training workload.

The Effort in Quotes

Q: Was this effective *Knowledge Transfer*?
Experienced SME: Yes. The use of video vs. a PowerPoint. You just get more out of it.
Junior SME: The natural conversations were a big value add.

Q: Do you think you would be able to make this kind of content, *if you were trained* on how to make it?
Experienced SME: Yes. After doing it a few times, I believe we could make a go of it here, with some help.
Junior SME : Yes, I definitely think we could.

Q: Can you describe what it was like producing this type of content? For example, *was it difficult or natural*?
Experienced SME: At first, we weren't sure how everything would go. Once we got into it, *Junior SME* and I got comfortable and got into a groove. We forgot about the cameras and just did our thing.
Junior SME : Once we saw the first clip, we understood it. We relaxed and it took a lot of pressure off. We didn't have to ACT…we could just be ourselves.

Q: Is this media-based approach, *a valuable tool* in the training toolkit?
Experienced SME: I agree with all of what *Junior SME* said. I think it brings a whole lot more than just sitting in the classroom, half-asleep.
Junior SME : Yes, it is very beneficial. It's hard to explain certain tasks, but with a video, they could see it. Fundamentals and basics are a really good fit for CBTs.

Would you *recommend* to include video and CBTs as a way to replace low-value classroom time:
Experienced SME: I'm all for it.
Junior SME: It's going to be situational based. This is what people like to do. They like to watch on their phone. This is way more engaging.