

# How to Train Your ~~Dragon~~ Simulator Engineer

January 14, 2020



# Agenda

- Introduction
- Why are we going through all this work?
- What do Simulator Engineers do?
- Where do Simulator Engineers come from?
- I've got a new recruit, now what do I do?
- What did I learn and how can we improve?

# About Me

- 6 years at Palisades Simulator
- 11 years with Entergy
- Information Technology background
- From zero experience to simulator lead in six years eight months

# The Palisades Simulator Engineer

- How did they build the first generation?



Pressure over Time



= Smaller  
Simulator staff +



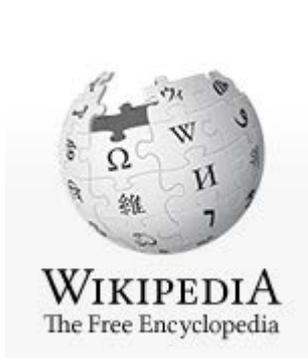
+ redistribution of  
knowledge among  
remaining staff



**Repeat until Knowledge is at desired density (2 engineers)**

\*Note: This simplified equation neglects the effects of any new knowledge introduced or the decay of existing knowledge

# Simulator Engineers: A Rare Commodity



x



+



≈

1,000 Simulator  
Engineers  
Worldwide  
220 Engineers US

459 World Reactors  
99 US Reactors

~2 Engineers per  
Simulator

Vendors and  
Free Agents

- Tend to stay in role for a long time
- Not usually interested in relocation
- Compensation is roughly equal across industry

Therefore: Very difficult to recruit

But really, why are we doing  
this?

# RETIREMENT

# What do I do all day?

- Maintain Simulator Code
- Maintain Simulator Hardware
- Maintain Simulator Fidelity
- But wait! There's more!

# Maintain Simulator Code

- Read and maintain ancient FORTRAN code
- Ability to figure out what legacy code does in the absence of good documentation
- Ability to adapt to differences introduced by new compilers
- Write useful comments in code
- Function well when Google and Youtube are of limited usefulness
- Know when to insist on bringing in a vendor to help

# Maintain Simulator Hardware

- Repair and maintain simulator I/O system like an Electrical Engineer
- Maintain simulator electrical systems and battery backup like an Electrician
- Maintain simulator computer and network equipment like an Information Technology Professional
- Maintain plant computer systems like plant Information Technology/Engineering
- Maintain physical fidelity like a Mechanic in a fabrication shop
- Maintain various other systems such as sound, video recording, phones, and anything else the plant can come up with.

# Maintain Simulator Fidelity

- Read plant drawings and engineering modifications like a Nuclear Engineer
- Write good test plans like a Work Planner
- Perform test plans like an Operations Instructor
- Understand plant and system response like an Operator
- Update the simulator core code like a Reactor Engineer
- Maintain completed test plans and other documentation like an Administrative Assistant

# But Wait! There's More!

- Support Assessments, Audits, and Inspections
- Subject Matter Expert on Simulator use for Instructors
- Source and order parts or work with Supply Chain
- Maintain Simulator budget
- Assist with scenario development, Emergency Planning Drills, and exams
- All the other fun “Nuclear Stuff”

# My Outage Job



05/14/2017

# Summary

- **A Computer Scientist comfortable working in a “dead” language that probably isn’t well documented which changes slightly with each new compiler. Also; proficient in Electrical Engineering, Electrical Maintenance, Information Technology, Mechanical Maintenance, Work Planning, Reactor Engineering, Plant Operations, Records Management, Supply Chain, Regulatory Affairs, budgeting, and a few other miscellaneous skills.**
- **\*Does all of the above while maintaining the FFD requirements for working at a Nuclear Facility**

# Where do Simulator Engineers come from?

- United States Navy
- Computer Science or Engineering college programs
- Other (Questionable IT-types)

Is this likely to satisfy our entire list of responsibilities?

Not without additional development

# You have TWO people, isn't that enough?

- **It is if you have these five simple things...**  
(click here to learn more)
- **Your simulator is running well with mature models**
- **You never do any major projects**
- **BOTH of them are capable of performing 100% of the required tasks independently**
- **Nobody ever leaves their position**
- **You are willing and able to fend off high-effort-low-value work**
- **\*Presenter makes no guarantee that satisfying these five conditions will lead to successful simulator operations**
- **OR you shut down the reference unit permanently**

# What were we looking for in a candidate?

- Experience solving first-of-a-kind problems
- Ability to adapt to changing requirements
- History of breaking down large projects into smaller tasks
- Software or Hardware background
- Understanding of nuclear power
- Plant-specific knowledge

# How did you do it, Mr. “Expert?”

- 3 months turnover with retiring hardware specialist – four page checklist of tasks
- Go forth and do great things!
- Do some work, learn some stuff
- Realize the scope of the job is massive (panic)
- Participate in a model upgrade and rehost project
- Validate that I have a lot more to learn but fail to develop a plan to address - I have “real” work to do...

# How did you do it, Mr. “Expert?”

## (Continued)

- “Kid, some day this will all be yours...” (panic again)
- Start compiling the list of things I don’t know (large)
- Raise concern to Training Dept Management
- Get a bunch of formal actions to close the gaps
- Attend Operations and Instrument & Control training
- Realize that I get to go through all of this again, but as the lead
- Write a presentation to ~~complain about how unfair life is~~ share my OE with my simulator peers

# What I have learned so far

- Maintaining good documentation is very important, often all I have to work with are the notes and manuals left behind by previous simulator engineers
- Nothing develops skill as quickly as actually doing the work
- Write detailed comments in your code
- Know how you meet your procedures and standards. Write it down!

# What I have learned so far (continued)

- Take advantage of your other training programs
  - Operations Generic Fundamentals
  - Operations Advanced Systems Training
  - Engineering Training
  - Instrument and Control Technician Training
- Understand why some parameters are more important than others
- Meet the experts so that you know who to contact when you need to get information for the simulator

# My takeaways from Operator training

- Generic Fundamentals
  - Understanding of physics modeled by the simulator
  - Understanding of failure modes
  - Ability to determine if a simulator malfunction is credible
- Advanced Systems training
  - Understanding of expected simulator response
  - Improved ability to determine the importance of equipment, malfunctions, and simulator response
  - Technical Specifications are very important to operators and not at all important to simulator engineers
  - It really is as difficult as the operators say
  - Our plant is a human factors nightmare

# My takeaways from Instrument and Control training

- “Tier Zero” training
  - Improved ability to read electrical circuit diagrams
  - Improved ability to troubleshoot hardware failures
    - Ability to mathematically analyze a circuit
    - Understanding how and why components work
  - Develop contacts with Subject Matter experts in the plant maintenance organization

# Okay, so you learned some stuff, how does that help?

- Developed skills inventory for Palisades Simulator Engineer
- Got familiar with identifying actions to close knowledge gaps
- Developed a detailed plan for the first year of new hire targeted to ensure the most important skills are developed first

# How's that working out for ya? (Challenges)

- HR processes very difficult to work through, reduced our new hire overlap from 6 months to 3 months
- Simulator availability limited due to high demand
  - Requal training
  - Initial License Class
  - Exam development/administration
- Shutdown in 2022, no more initial license classes
- No plan survives contact with reality, need to be flexible

# What has worked so far (Successes)

- Take your new hires to industry conferences!
- Spend a lot of time in the simulator booth with the simulator instructors
- Use existing documentation to teach, revise or create as you go
- Take advantage of simulator failures to teach troubleshooting and repair process
- New hire accountable for own success and has a list of actions and due dates to support

# Executive Summary

- Plan on starting from scratch with a new hire
- Inventory all simulator skills and tasks
- Plan specific activities to develop and demonstrate proficiency
- Use your Training Department
- Be flexible enough to take advantage of training opportunities as they arise
- Documentation!

# Questions?

- Joe Poisson
- 269-764-2704
- [jpoisso@entergy.com](mailto:jpoisso@entergy.com)