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HyRAM – Hydrogen Risk Assessment Models

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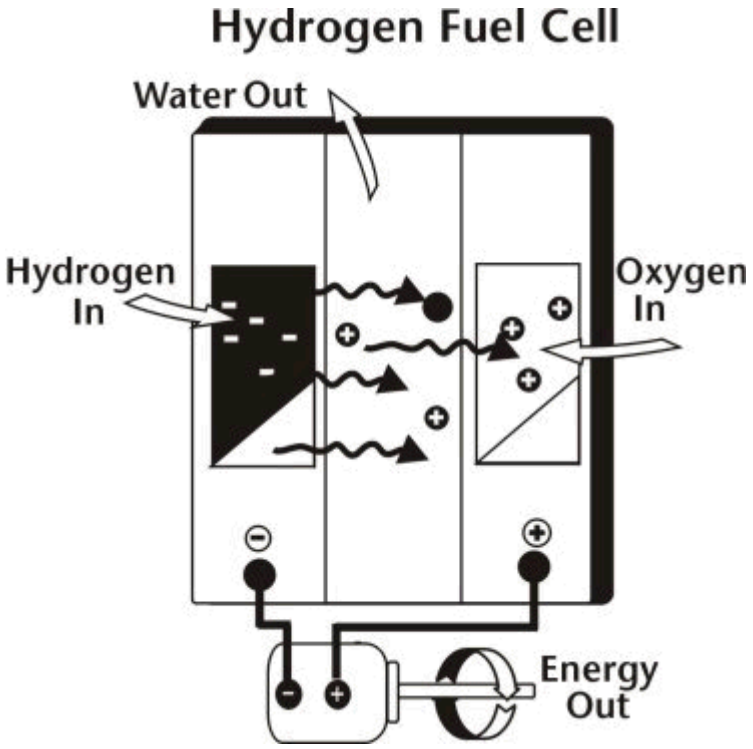
Hydrogen Fuel

- Economy
  - Low-carbon energy source
- Environment
  - Water is the only byproduct



http://www.globalization101.org/hydrogen-power-and-fuel-cells/

Uses of Hydrogen

- FCEV – Fuel Cell Energy Vehicles
  - Zero emissions
  - Fast refueling

http://auto.howstuffworks.com/fuel-efficiency/hybrid-technology/hydrogen-cars1.htm

http://altuslift.com/blog/hybrid-vs-hydrogen-fuel-cell-forklift-possible-future/

Who is the customer?

- DOE (Department of Energy)
  - FCTO (Fuel Cell Technologies Office)
  - Program Goal:

    "To enable a commitment by automakers no later than year 2015 to offer safe, affordable, and technically viable hydrogen fuel cell vehicles in the mass consumer market"

Who Cares?

http://www.caranddriver.com/toyota/mirai

- Car Companies (Toyota, BMW, Honda, Hyundai)
- Fuel Companies (Linde, Praxair, Air Products, Air Liquide, Shell)
- Hydrogen technologies companies
- Codes and standards organizations
- Target Markets: California, Hawaii, Germany, Japan and more
- Future Areas of Application

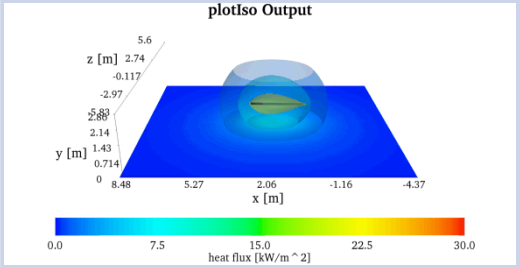
Potential Dangers of hydrogen

- Highly flammable (like all fuels)
  - Could cause burns, building fires, explosions
- New fuel, different physical properties
- New systems and applications

- Difficult to compare

HyRAM

- What is HyRAM?
- How does it work?

QRA	Physics	PBD
• System Description • Scenarios • Data/Probabilities • Consequence Models • Scenario Stats • Risk Metrics	• Overpressure • Jet Flame 	• Performance Based Design

Purpose of HyRAM

- QRA – Quantitative Risk Assessment
  - FAR – Fatal Accident Rate
  - AIR – Average Individual Risk
  - PLL – Potential Loss of Life
- Safety
- Standardization
  - ISO – International Organization of Standardization
  - Fire codes

Accomplishment: Wrote Tutorial

- Become familiar with HyRAM
- Indoor Fueling Example
  - Story
  - Example
- Test user

Accomplishment: Maritime SAND Report

- Hydrogen generator located on a barge
  - What risk are dock workers facing?

http://archives.starbulletin.com/1999/08/05/business/index.html

http://www.destination360.com/north-america/us/hawaii/oahu/oahu-map

Accomplishment: Identifying Issues with HyRAM

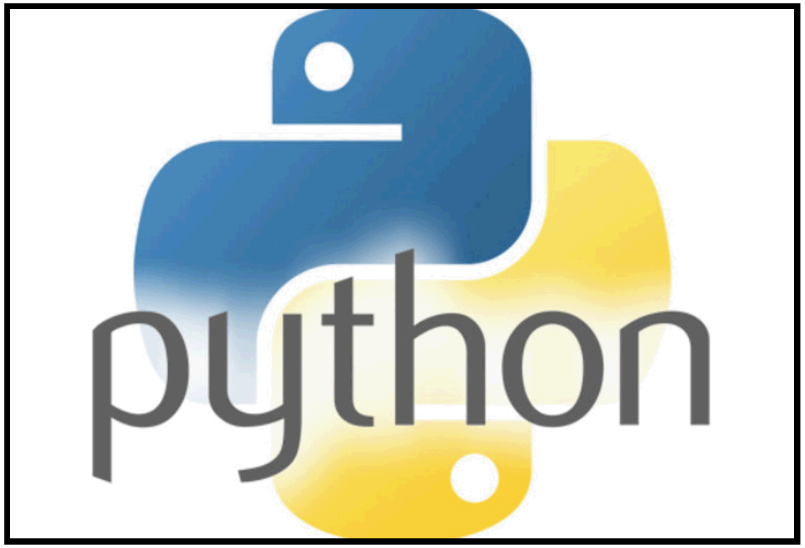
- Bugs
- H2zilla
  - Brief description
  - Every step
  - Possible solutions

HyRAM Programming

- HyRAM is new and innovative software, being created by a very motivated and energetic group
- Was easy to join Team HyRAM and work toward their goal of giving the Nation a high quality Hydrogen Power safety software
- I began my Internship, working mostly on Python code to fix some of those bugs

Accomplishment: Learning Python

- New to Python and Programming
  - Learned the basics of Python from my mentor and books
  - After I learned the basics I started fixing HyRAM



HyRAM Meetings

- Monthly meetings with Team HyRAM
- These meetings helped find bugs and solve problems
- Allowed the team to talk about needed improvements
- These monthly meetings are a key step in HyRAM's development

Creating a Good Product through Testing

- From the monthly meetings I was able to find out what needed to be done and start a plan to complete it
- Start working on program
- Work through errors and test again(most likely repeat this step multiple times)
- Once the program is completed, I implement it into HyRAM and see if the program works with the rest of HyRAM

Accomplishment: Generate a module to document the code

```
25 Filenodes = []
26 def walk(dirname):
27         for filename in os.listdir(dirname):
28             path = os.path.join(dirname, filename)
29             if os.path.isfile(path):
30                 if filename.endswith('.py'):
31                     path1 = path.replace('C:\Users\darjohn\Desktop\qra\software\p
32                     thisFilenode = Filenode(path1)
33                     Filenodes.append(thisFilenode)
34                     #print path1
35                     with open(path) as f:
36                         for line in f:
37                             if line.startswith('def'):
38                                 funname_args = line.replace('def', '')
39                                 funname_args1 = funname_args.split('(')
40                                 funname = funname_args1.pop(0)
41                                 #print funname
42                                 thisRoutine = Routine(funname)
43                                 thisFilenode.Routines.append(thisRoutine)
44                                 args = funname_args1.pop(0)
45                                 args1 = args.split('):\n')
46                                 args2 = args1.pop(0)
47                                 args3 = args2.replace(', \n', '')
48                                 args4 = args3.replace(',\n', '')
49                                 args5 = args4.split(',')
50                                 #print args5
51                                 thisArgument = Argument(args5)
52                                 thisRoutine.Arguments.append(thisArgument)
53                                 for optargs in args5:
54                                     #if '=' in args5:
55                                     optargs = args5.index('=')
56                                     print optargs
57                                         #oparg = args5.pop(optargs)
58                                         #print oparg
59
60
61             else:
62                 walk(path)
63
```

What's next for HyRAM work?

- Tutorial gets distributed to first users
- Maritime report starts publication process
- Team HyRAM uses module to plan software additions

What's next for us?

- Hannah
  - Mechanical Engineering
  - Texas A&M
- Darryl
  - Mechanical Engineering
  - Westpoint

http://www.garmentgraphics.net/united-states-military-academy/

http://bionews-tx.com/news/2015/02/12/texas-am-back-on-americas-top-20-research-universities-roster/

What we learned

- How Sandia works
  - Ins & Outs
  - Outlook
- Professional office setting
  - Conduct
- Expectations vs. Reality

Summary

- Main accomplishments
  - Hannah
  - Darryl

Questions?