Updating a PWR Simulator in Python

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Outline

Presentation Outline

- Introduction and Background
  - Motivation and Goals
  - Original Fortran
- Physical Models
- Graphical User Interface
- Conclusion

Introduction and Background

Motivation

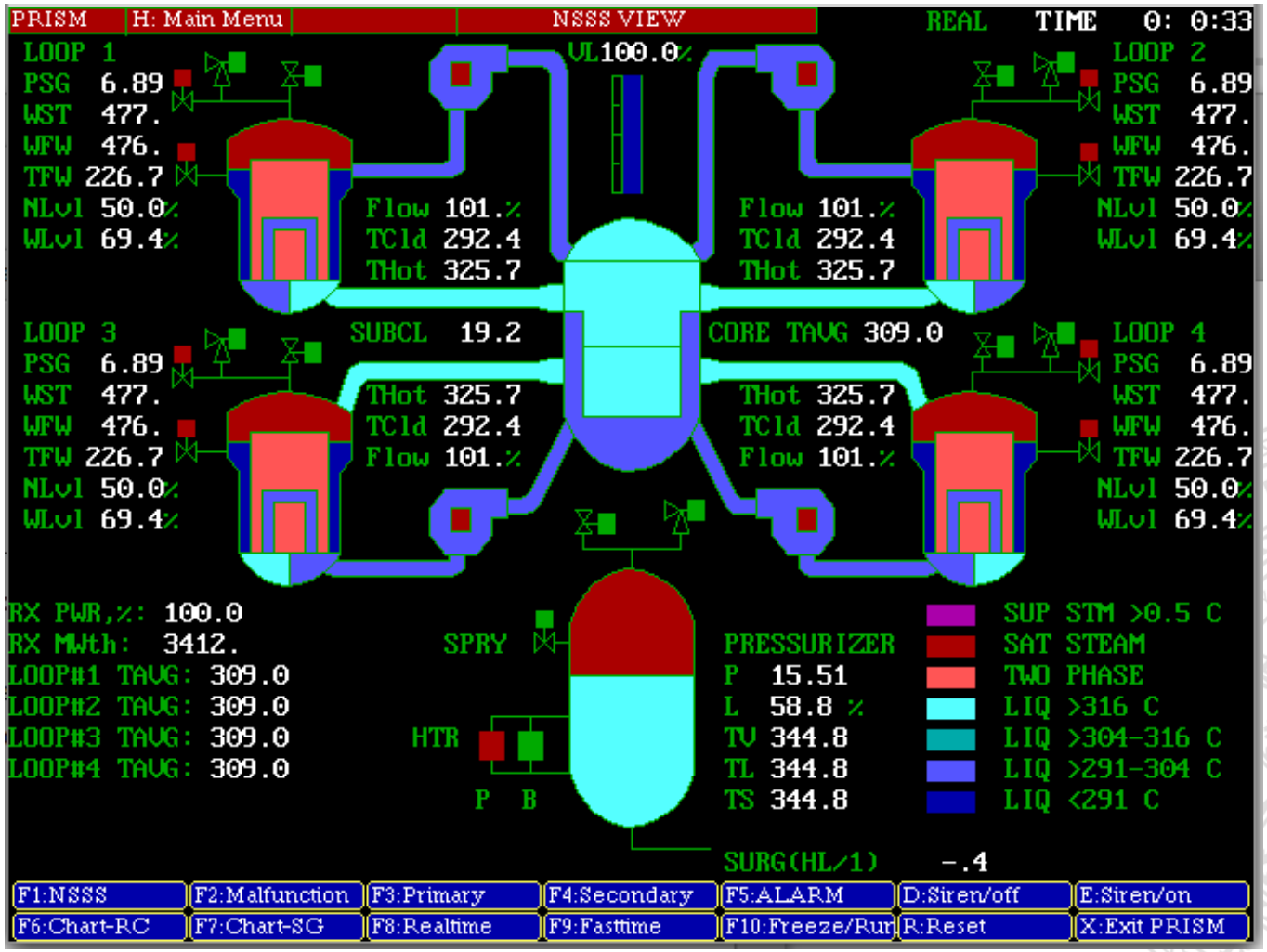
- PRISM only works on DOS
- PRISM is useful for teaching tool
- Python and Kivy are cross platform and modern languages

Goals

- Translate Physical models from Fortran 77 to Python
- Recreate GUI using Kivy Library
- Validate the results against original PRISM
- Support cross-platform versions of program

Original Fortran

Screenshot of the Landing Page for DOS based GUI



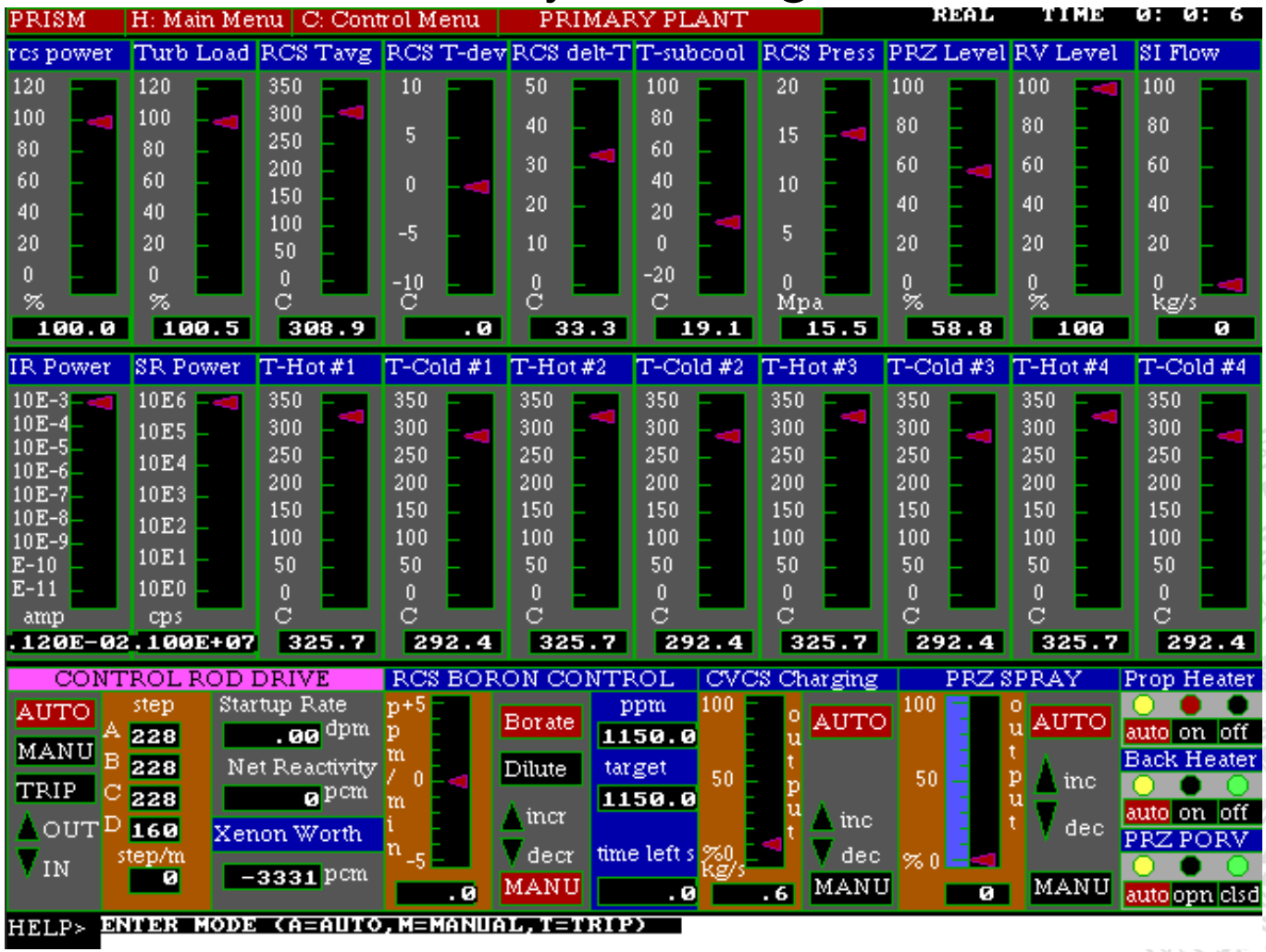
Original Fortran

Screenshot of the Malfunction for DOS based GUI

```
                          MALFUNCTION MENU          Current Time   0: 0: 4
 No.      MALFUNCTION          Status (s)  No.      MALFUNCTION        Status (s)
 1. Reactor Trip               InActv      13. Turbine Trip Fail       InActv
 2. Turbine Trip               InActv      14. Main Steam Iso. Fail    InActv
 3. Auto SCRAM Fail            InActv      15. Aux. FW Fail to Start   InActv
 4. Loss of Offsite Power      InActv      16. Prz Safety Fail Open    InActv
 5. Main FW Isolation          InActv            % Valve Open:              .0
 6. Prz PORVs Fail Closed      InActv      17. Reactivity Accident     InActv
 7. Turbine Load Rejection     InActv            Step Change (pcm):         .0
      % of load rejected:        .0
                              LOOP #1        2          3          4
 8. Steam Line Isolation      InActv      InActv     InActv     InActv
 9. Small-Break in Cold Leg   InActv      InActv     InActv     InActv
      Break Diameter (cm)      .0000       .0000      .0000      .0000
10. SG Tube Rupture           InActv      InActv     InActv     InActv
      No. Tubes Ruptured          0           0          0          0
11. SteamLine Break bf. MSIV  InActv      InActv     InActv     InActv
      Break Fraction (%)          .0          .0         .0         .0
12. FeedwaterLine Break       InActv      InActv     InActv     InActv
      Break Fraction (%)          .0          .0         .0         .0
Enter 0 to Exit Malfunction Menu
Please Enter Malfunction No.(0-17): _
```

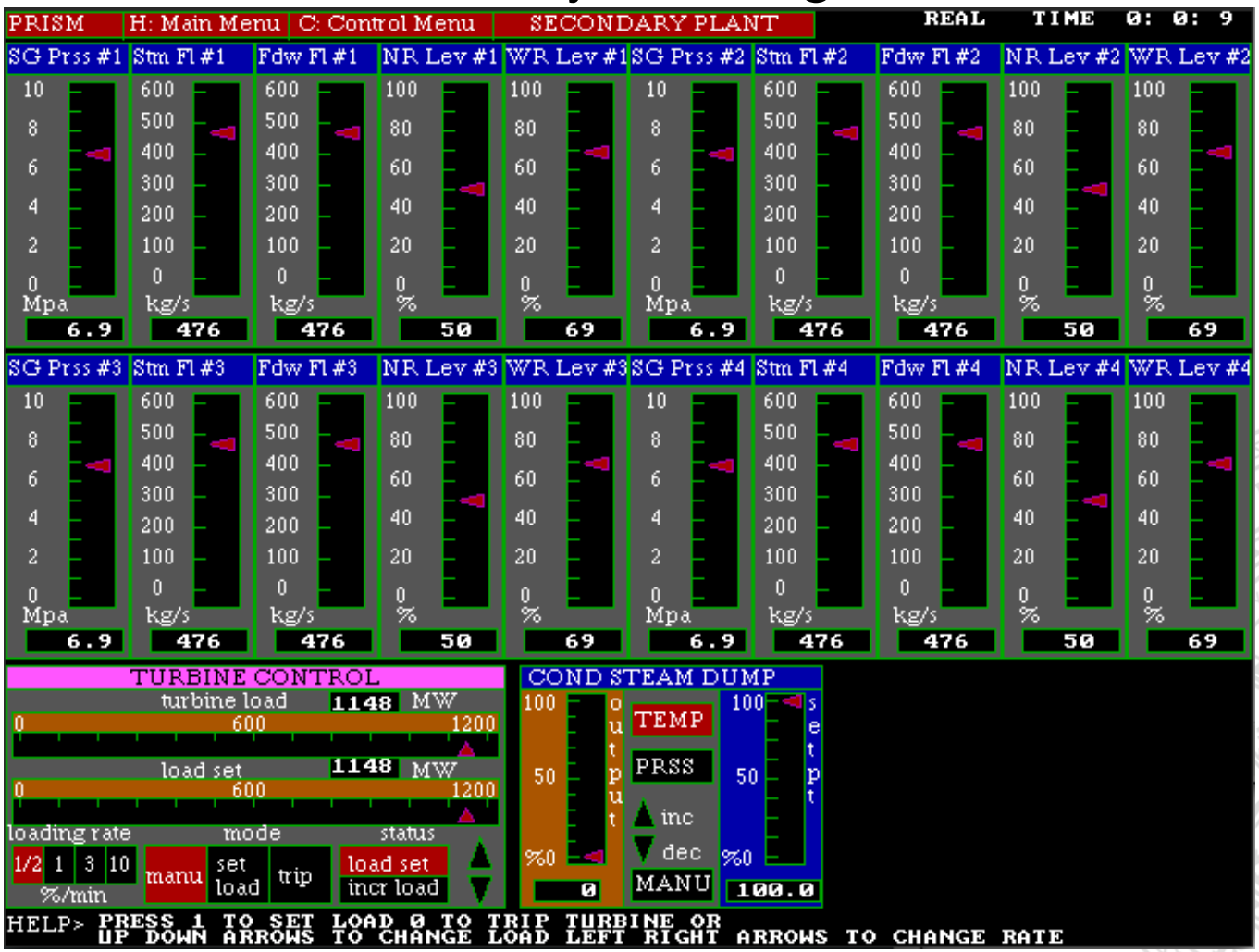
Original Fortran

Screenshot of the Primary Data Page for DOS based GUI



Original Fortran

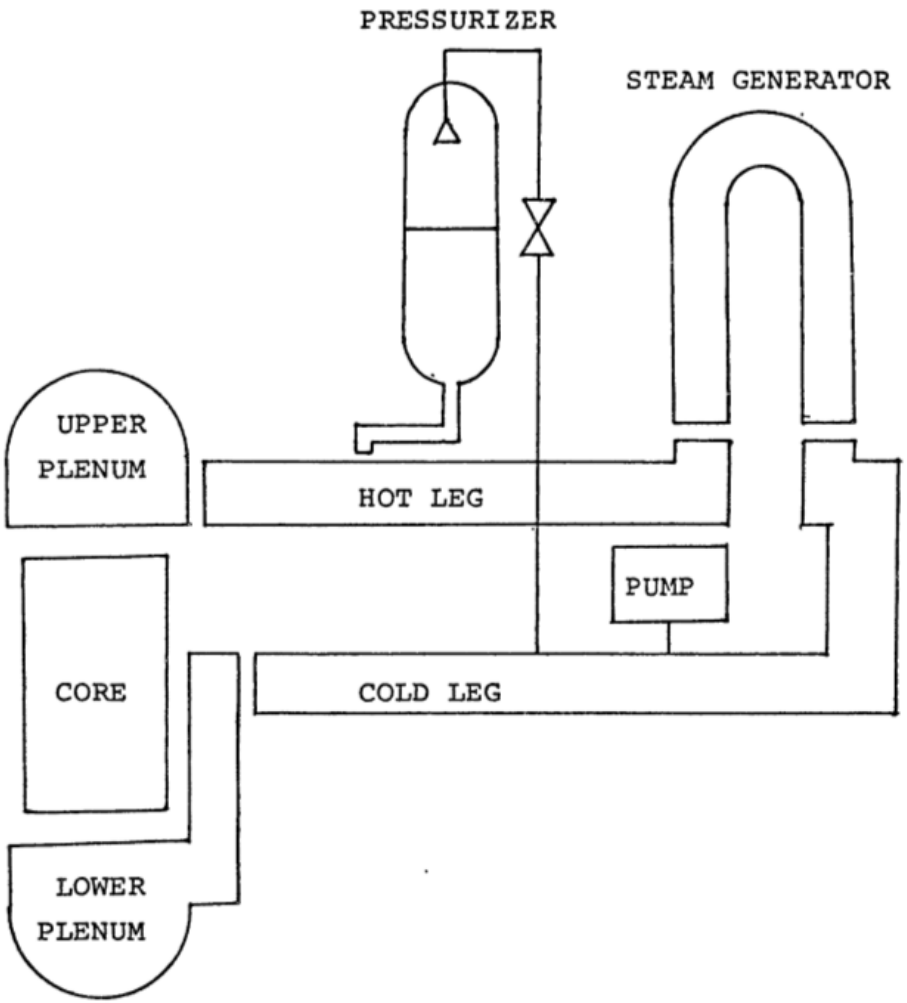
Screenshot of the Secondary Data Page for DOS based GUI



Original Fortran

Screenshot of the Alarm Panel for DOS based GUI

PRISM Noding Scheme



Component Models

Core Model

- Point kinetics model with 6 delayed groups
- Lumped-fuel heat transfer model
- Single Node Model

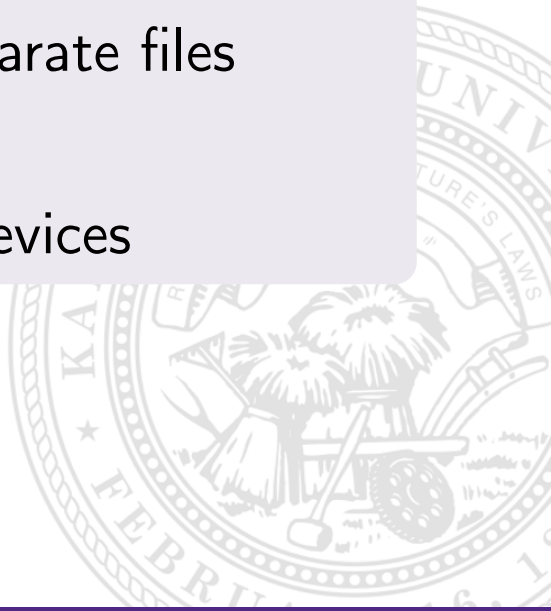
Pressurizer Model

- Uniform properties in each phase
- No metastability in either phase
- Rainout prevents subcooling by maintaining sat vapor
- Flashing prevents superheating by maintaining sat liquid
- Spray enters the vessel as a sat liquid
- No heat is transfered at the liquid-vapor interface

Graphical User Interface

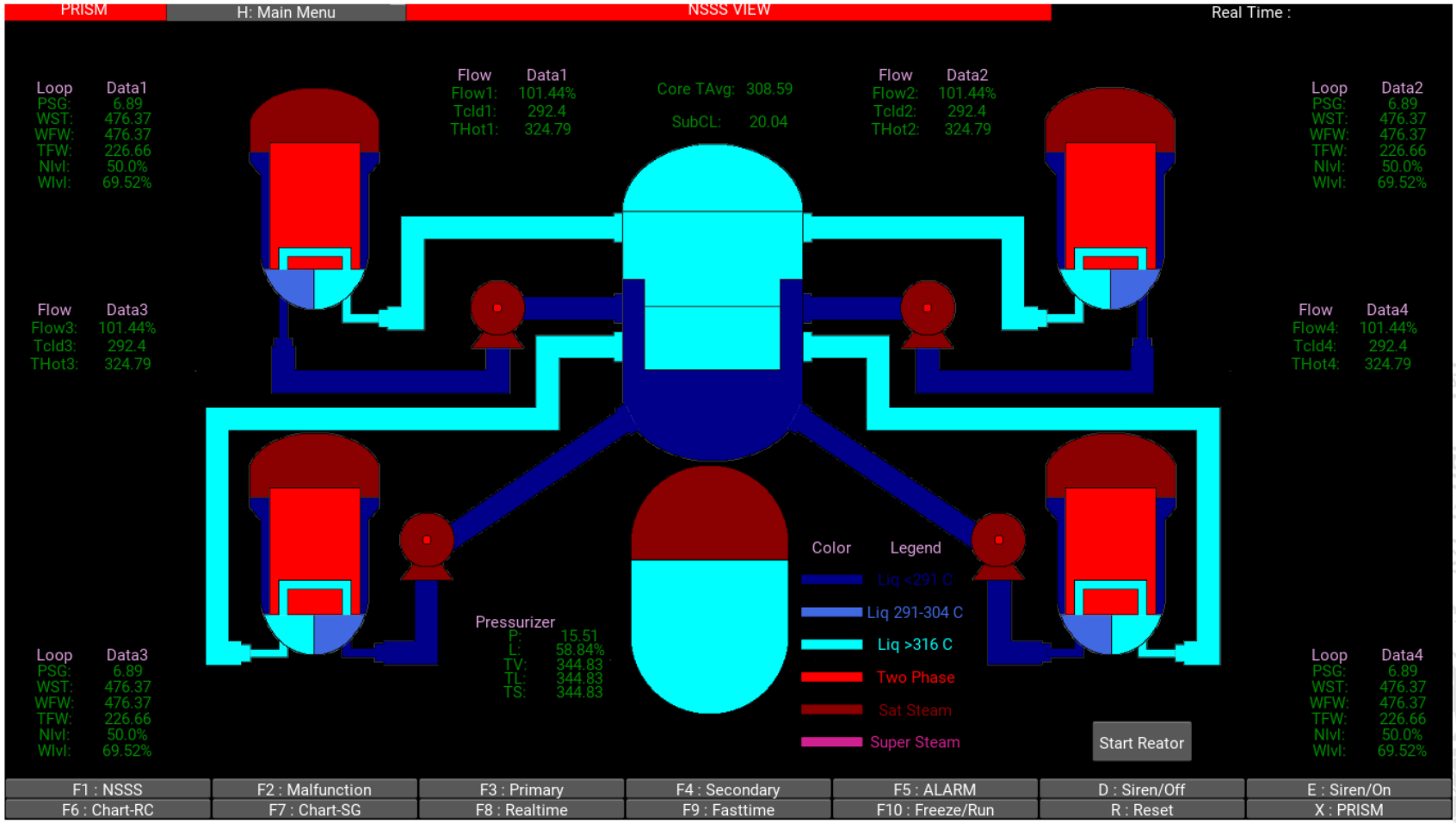
Kivy Library

- Created in February 2011
  - Matthew Virbel and others
  - French Programmer
- Separates mechanics and graphics into two separate files
- Python library that uses the KV language
- Designed to port to all platforms and mobile devices



PRISM Redesigned

Updated landing page designed with Kivy



Conclusions

Conclusions

- DOS based PRISM is outdated
- Python and Kivy are used to update PRISM
- Program will be used as teaching tool primarily
- Nearly completed implementation

Future Work

- Verification and Validation
- Deploy on various platforms
- Update physical models

Acknowledgements

Kansas State Electrical Power Affiliates Program (EPAP)

References I

- CORPS-G, "prism-dev physical model documentation," (2016), http://corps-g.github.io/prism-dev/.
- CORPS-G, "kivy-miniapps repository," (2016), http://github.com/corps-g/kivy-miniapps.
- S.-P. KAO, *A Multiple-Loop Primary System Model for Pressurized Water Reactor Plant Sensor Validation*, Ph.D. thesis, Massachusetts Institute of Technology (1984).
- "Python Kivy Library," http://kivy.org.