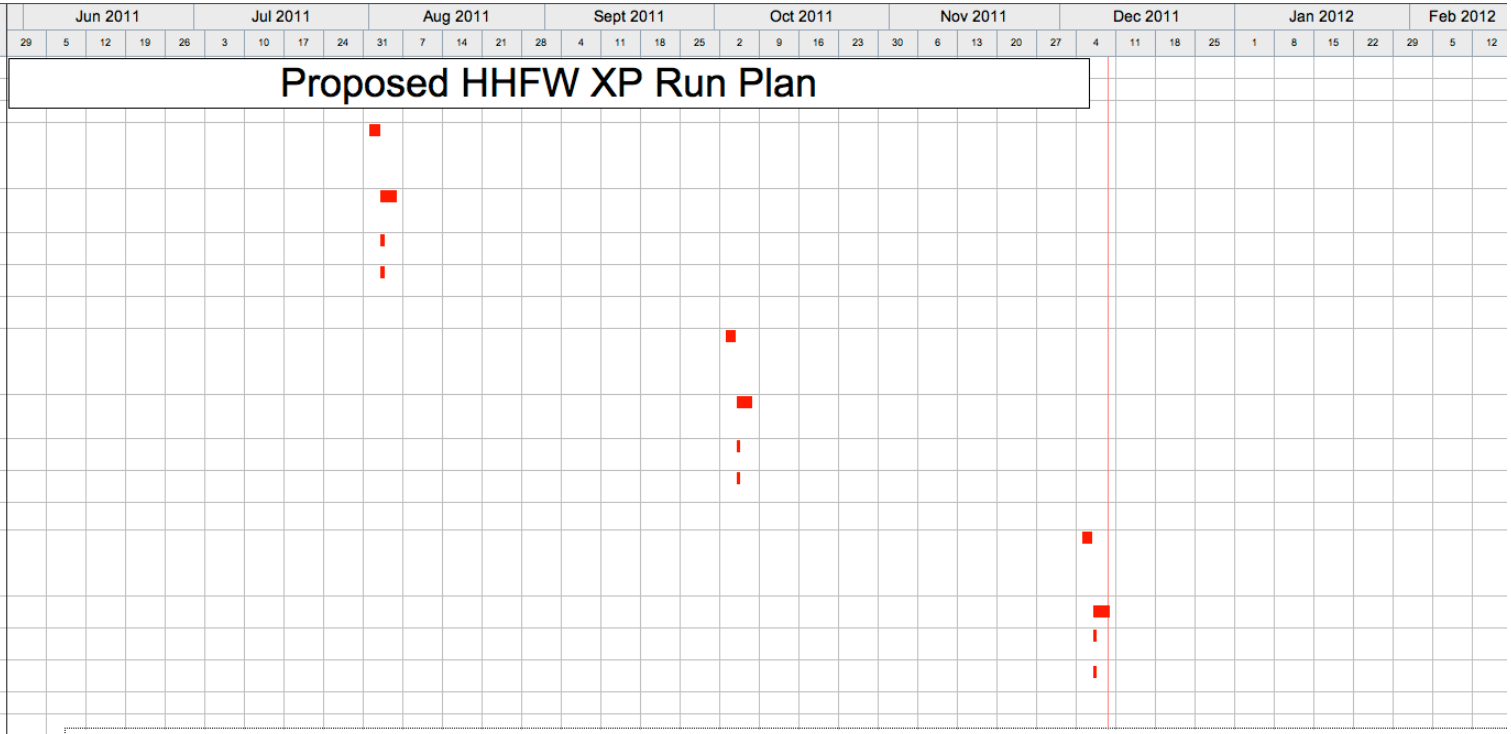
Proposed HHFW XP Run Plan and XP#1 Experimental Schedule

J. Hosea 4/26/11

Activity Name	Duration (Work Days)	Start Date	Finish Date
Plasma Conditioning	2.00	8/1/11	8/2/11
HHFW XPs	3.00	8/3/11	8/5/11
- Maingi	0.25	8/3/11	8/3/11
- Diallo	0.25	8/3/11	8/3/11
Plasma Conditioning	2.00	10/3/11	10/4/11
HHFW XPs	3.00	10/5/11	10/7/11
- Ryan/Green	0.25	10/5/11	10/5/11
- Hosea/Perkins	0.25	10/5/11	10/5/11
Plasma Conditioning	2.00	12/5/11	12/6/11
HHFW XPs	3.00	12/7/11	12/9/11
- Hosea/Perkins	0.25	12/7/11	12/7/11
- Hosea/M. Bell	0.25	12/7/11	12/7/11



- 2 days conditioning followed by 3 days of HHFW XPs
- 3 x 5 day periods sequenced 2 months apart

Plan for combined XP1 proposals - 0.5 days in FY11, 1 day in FY12:
- XP#1 (WPI- 5, 6, 16, 20, 24,25) - run elements first after plasma conditioning in sequence shown
- XP#1 (WPI- 7) - piggyback with conditioning

Plasma conditioning:

- 1st day:
  - He to maximum power
    - With NB pulse to measure T_i
    - Start with -90° phase, follow with -150° and +90°

- 2nd day:
  - Continue with helium if $P_{RF\ level}$ is still improving
  - D_2 to maximum power
    - With NB pulse
    - Phase comparison
  - D_2 with 2 MW NBI throughout RF pulse

Backup work:

- Vacuum conditioning - before Li (June), 1 night/week during run, prior to plasma conditioning runs

- Apply HHFW to morning fiducial - 1 morning per week, after vacuum conditioning the previous night

Critical Diagnostics:

- Usual: TS, CHERS, ERD, MHD, EFIT, etc.

- Additional diagnostics especially important for conditioning and XP phases:
  - Cameras — Roquemore
  - Soft X-ray — Tritz
  - Fast IR at H — McLean/Ahn (strike radius and RF hot zone in view if possible)
  - IR at I and G — Gray
  - High k scattering — Ren
  - Probes — Perkins, Zweben, Gerhardt, etc
  - Reflectometer — Kubota, Wilgen

R. Maingi WPI-20: Comparison of H-mode pedestal characteristics with RF and NBI

- Plan for 8 shots (1/4 day):
  - minimize PLH, which means Double-null configuration
  - similar outer gap: 10 cm ideal, 8 cm ok
  - Min. Ip for good NBI absorption, while max. for RF-only H-modes: 0.6-0.7 MA?
  - Best absorption characteristics -> 0.5-0.55 T?
  - 3 point shot-to shot RF power scan: 2 MW, 3 MW, 4 MW?
  - optimum lithium for RF discharges with small ELMs (not ELM-free) - we'll have to see practically what this means
  - comparison NBI discharges in the same shape

❖ If the machine is running really well and we've had rf only H-modes before this point, I would guess 1 hr to develop the discharges, 1 hr to get the RF data points, and 1 hr to get the corresponding NBI datapoints. I hope I can get someone else to pay for the NBI comparisons.

(BTW Jeremy Lore is a postdoc at ORNL who is interested in these comparisons, as he will be comparing ECH and NBI H-modes at DIII-D and he will plan to work with us.)

A. Diallo WPI-25: Plasma current scaling of the pedestal structure in RF heated ELMy H-mode

- Plan for 8 shots (1/4 day):
  - ❖ The aim will be to get ELMy H-mode withPNBI =2 MW and PRF= 2MW, and outer gap maintained between 8 - 9 cm

  – Start a current scan fixed triangularity (high delta = 0.6), BT =0.45 T

    1) Ip = 700 kA (2 shots)
    2) Ip= 900 kA (2 shots)
    3) Ip= 800 kA (2 shots)
    4) Try 1MA (2 shots)

    else let Ip = 900 kA and increment PRF by 0.5 MW (2 shots)

P. Ryan and D. Green WPI-24: Benchmark Predictive Capability of Advanced Quasi-linear RF Simulation Codes

- Plan for 8 shots (1/4 day):

✧ Aim is to benchmark AORSA code for RF/edge interactions - coaxial eigenmodes in the SOL and edge propagating whistler modes.

1) Antenna phase scan in helium L-mode:
   - Antenna phase = 150 (or 180), -90, +90, -30, and +30. (5 shots)

   The He plasma will allow the edge rotation diagnostic to look at the He lines to get good signals.
   - will look for ion heating at the radius where the surface whistler waves are expected. In L-mode AORSA predicts these effects for co- but not for counter-CD phasing.
   - at the same time, will operate the reflectometer in dwell mode to get the PDI spectrum
   - will also be looking at IR-camera heat distributions, and B-dot probe signal amplitudes.

3) -90°/+90° degree comparison in modulated HHFW heating of NBI H-mode (3 shots)
   - The ERD can look at carbon lines.

J. Hosea and R. Perkins WPI-6: RF Heating at Divertor/ SOL Regions

- Plan for 8 shots (1/4 day):

✧ Aim is to "probe" the RF "hot" zone and antenna/edge interactions – determine if RF edge heating is a wave effect or near field effect or both

1) Scan hot zone in major radius with magnetic field pitch in NBI D_2
   - Scan I_P/B_T: 0.5 MA/5.5 kG, 0.7/5.5, 0.9/4.5, 1.1/4.5 (4 shots) (may be adjusted)
   - Make measurements with RF probes, divertor and antenna probes, tile rogowski detectors, IR cameras, cameras, high k scattering, etc.

2) Repeat scan of hot zone in HHFW helium discharge (diagnostic NB pulse only)
   - Lower edge density in helium may facilitate measurements by reducing edge heating at high power (4 shots)

J. Hosea and R. Perkins WPI-5: Study HHFW Power Coupling Versus ELM Activity

- Plan for 8 shots (1/4 day):

✧ Aim is to apply maximum RF power into an ELMy 2 MW NBI heated H-mode in D_2

1) Scan RF power, I_P, antenna-plasma gap to optimize core heating at -90° phasing
   - Start with conditions of shot 135325 (0.8 MA, 5.5 kG, 5 cm gap, P_{RF} ~ 2.6 MW, P_{NB} ~ 2 MW) (1shot)
   - Increase P_{RF} to ~ 4 – 5 MW (2 shots)
   - Increase Gap to 7 cm with maximum RF power (2 shots)
   - Increase I_P to 1 MA, maximum P_{RF}, best gap (1 shot)

2) Repeat 0.8 MA and 1.0 MA cases with best gap and P_{RF} for antenna phasing of -150° (2 shots)

J. Hosea and M. Bell WPI-5 &WPI-16: 1) Study HHFW Power Coupling Versus ELM Activity and 2) HHFW Heating to Increase Non-Inductive Current Fraction in NBI H-modes

- Plan for 8 shots (1/4 day):

1) Apply maximum RF power into an ELMy 4 MW NBI heated H-mode in D_2 (4 shots)
   - Look for higher P_{NB} effect on ELMs and and edge heating

2) Apply maximum RF power to increase non-inductive current fraction in an ELMy NBI heated H-mode in D_2 (4 shots)
   - Setup shot of Howard Yuh #..... with monotonic q profile
     - Increase P_{RF} in steps to maximum sustainable (~ 4 – 5 MW?)