Long Range Transmission Planning

Technical Study Update

Planning Advisory Meeting

March 17, 2021

Purpose & Key Takeaways

Purpose:

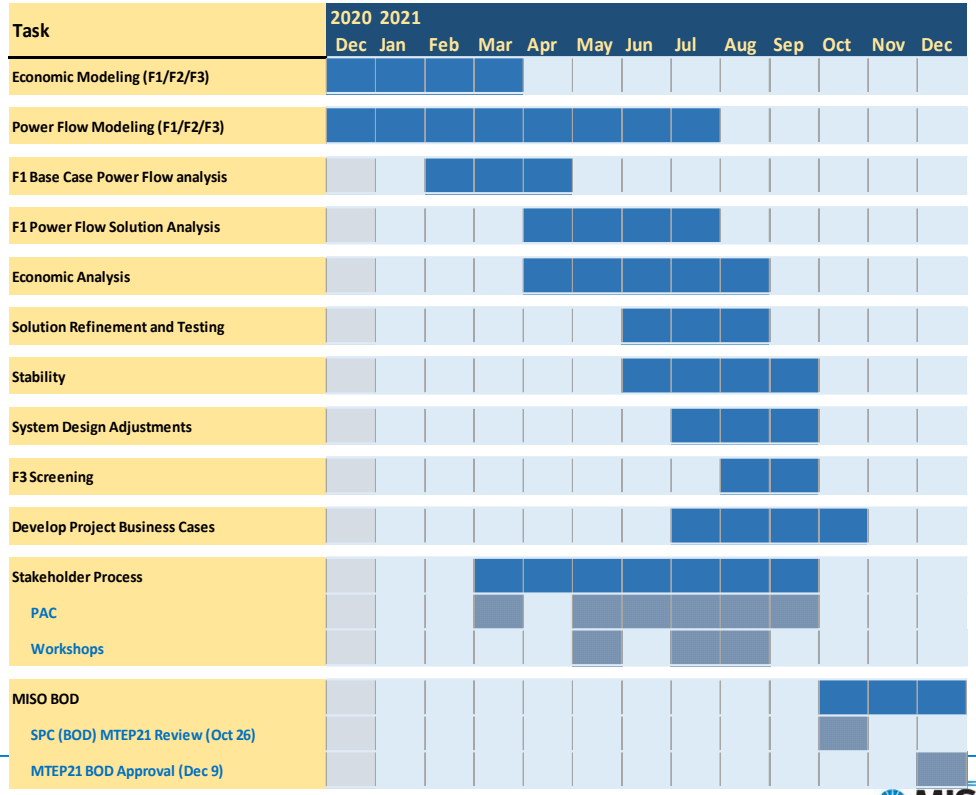
Provide schedule details for MTEP21's Long Range Transmission Planning (LRTP) efforts

Key Takeaways:

- LRTP analysis effort is focused on identifying solutions needed to enable the resource transition in progress
- Reliable system performance as well as economic values will be identified throughout the multi-year process
- MISO staff will recommend additions to the regional plan as preferred solutions are identified
- Pace of transition dictates urgency in evaluating and recommending initial needs for MTEP 21

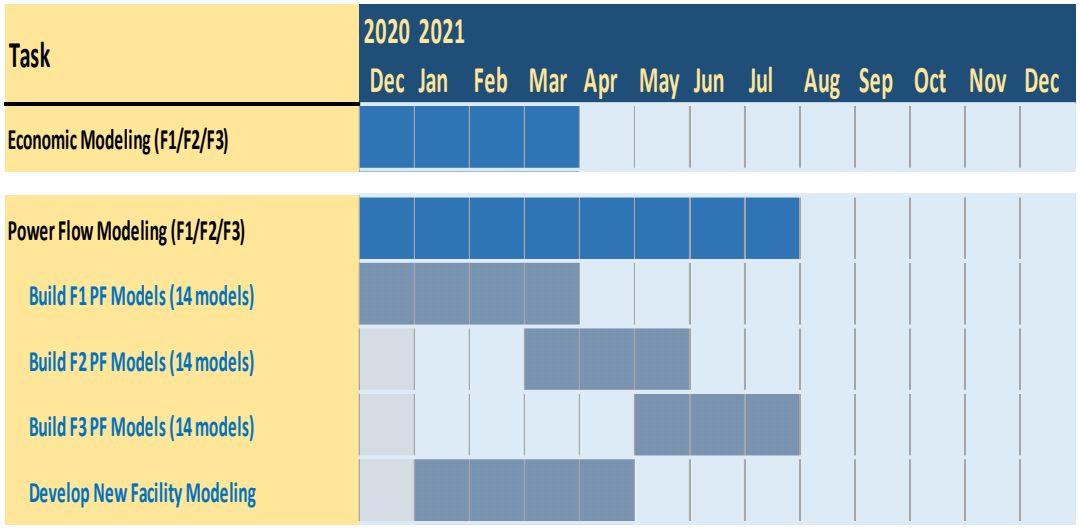
Identification of Future 1 needs is initial focus for MTEP 21

- Stakeholder workshops planned across the summer but study progress will dictate actual timing
- PAC will be updated between workshops
- October SPC will be final milestone for recommended Appendix A projects



Modeling is key, and we are taking time to develop numerous representations of the various Futures

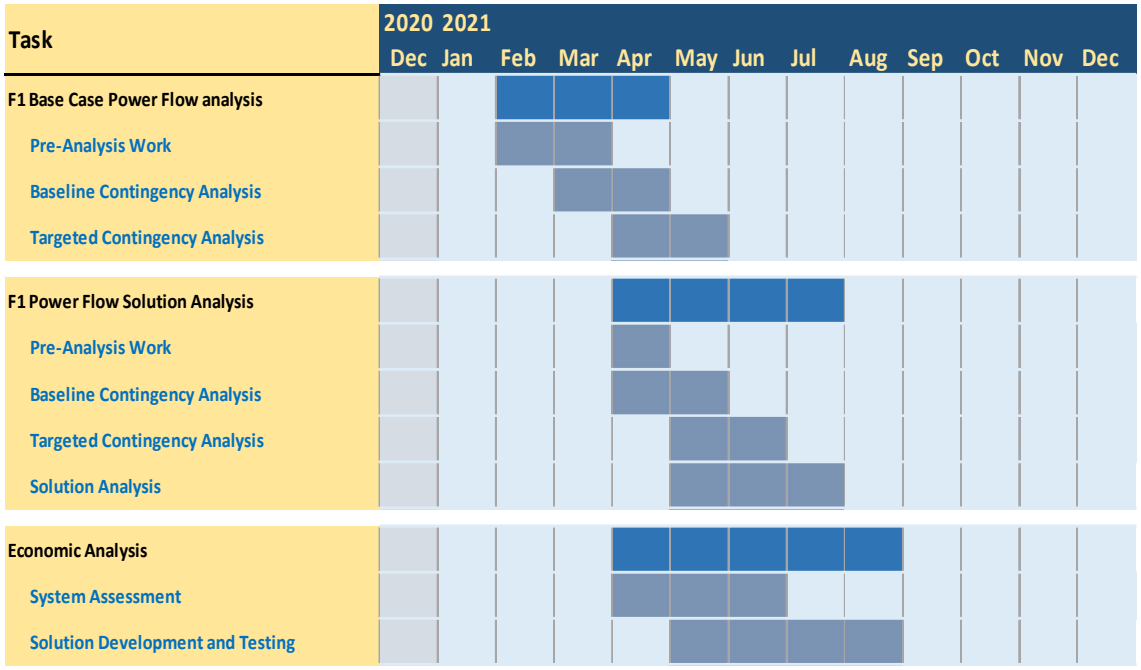
- Nearing end of model building phase
- Futures have presented significant complexities and challenges
- Future 1 power flow building has been fruitful in establishing tools/process efficiencies that will make Future 2/3 faster to build



- Future 1 power flow models will be posted in March – more info will be provided as these are ready to post
- Initial set of economic models were posted in February (Future 1/2/3)

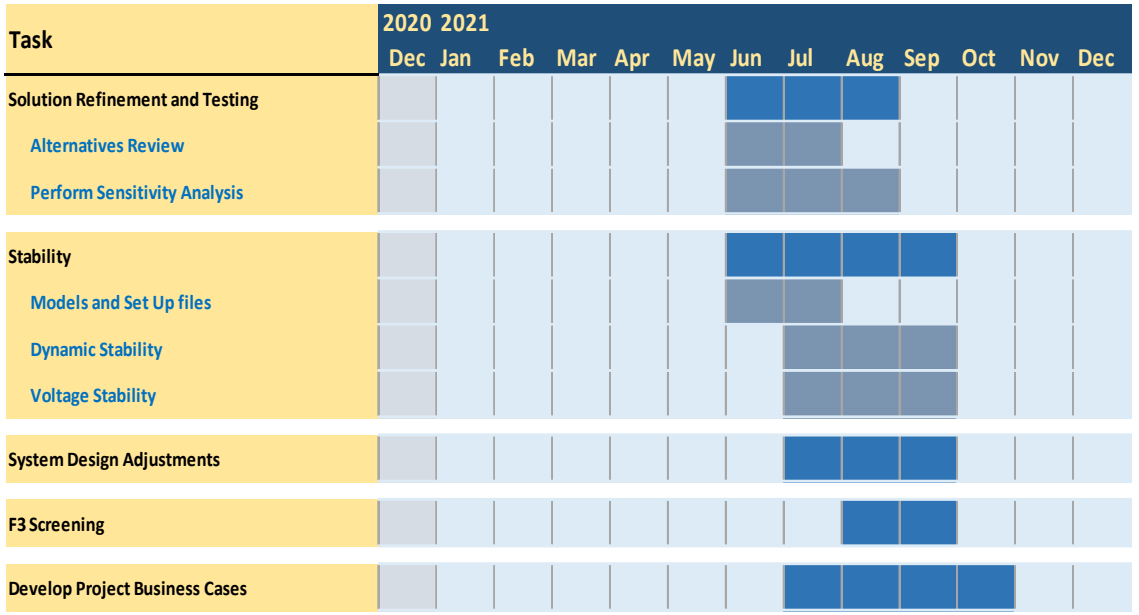
Significant penetration of inverter-based generation presents different challenges as uncovered by RIIA – reliability is expected to be a major driver for LRTP

- First step is to understand the base foundation of reliability issues – understandings gained from RIIA will guide this effort
- Solution options considered will include MISO idea's as well as those received by stakeholders
- Economic analysis will be an iterative effort with reliability work and will enhance the solution development
- As always during planning efforts, MISO will seeks input from Stakeholders as issues and potential solutions are identified



The major efforts – reliability and economics will work together to provide significant insights driving the final outcomes and business cases

- Stability efforts will focus on dynamic and voltage but as results dictate, additional work may be required
- Results of the economic and stability work may drive adjustments to solutions
- Solutions will be screened against Future 3 to ensure no regrets



Initial analysis will identify areas of higher stress that require more attention

- Steady State Analysis
  - Thermal and voltage analysis
  - Multi-directional transfer analysis between regions
  - Surge Impedance Loading (SIL)
- System Stability
  - Dynamic stability
  - Voltage stability
  - Inverter based issues - Short circuit ratio (SCR) screening – provides insights into voltage strength and stability weakness
- Robustness Testing
  - Sensitivity analysis (additional scenarios)
  - Solution testing including Future 3 screening
- Economic Analysis
  - Renewable energy enabled vs limited renewable energy enabled
  - Congestion and energy served
  - Emergency and unused energy
  - Adjusted production cost

Next Steps

- Will provide information to access power flow models once they are posted
- Workshop anticipated in early May to discuss analysis results and next steps
- PAC update in May to provide recap of Workshop

Contact Information

Jarred Miland (jmiland@misoenergy.org)

Matt Tackett (mtackett@misoenergy.org)