

PG&E Wildfire Risk Modeling Overview





Safety


Earthquake
Duck, Cover & Hold

Emergency Plan & Exit Strategy
Have a plan for yourself and your household

24/7 Nurse Care Line
If you experience a work-related discomfort or injury, call [REDACTED] and notify your supervisor.


Wash your hands!


Wear a Mask


Practice social Distancing

Meeting Agenda

Date: 11/13/2020

Desire Outcomes: TBD

Meeting Agenda				
	What - Content	Who - Facilitator(s)	Slide Number	Duration
1	TBD			
2				
3				

Action Item Review



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Action Items				
Workstream	Action Item (Initial Date)	Description	Resolution	Date
Enhanced Vegetation Management	EVM Risk Buydown Curve WGR - 11/9/2020	Plot and show the 1130 miles (80% Over Work that needs to be finished EVM - 02) Dike Tree and (Weighted) Risk Buydown		11/13/2020
Enhanced Vegetation Management	EVM programs timeframes WGR - 11/9/2020	Determine the EVM program timeframes and compare them to the current tree weighted risk		11/13/2020
Enhanced Vegetation Management	EVM programs and resources WGR - 11/9/2020		In Process - Review of other programs underway	TBD
Enhanced Vegetation Management	System		In Process - Current scoring appears to not have operational efficiencies with hardening	11/13/2020
Enhanced Vegetation Management	Tree density	Tree density from the 2018 and 2020 LiDAR data and compare to the 2011-2012 LiDAR data to show future work 2021, 2022	Road Mapped - LiDAR tree density will be examined for inclusion in future risk modeling	TBD

To be discussed in working session



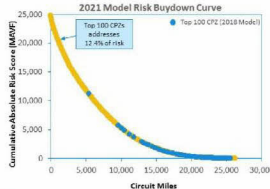
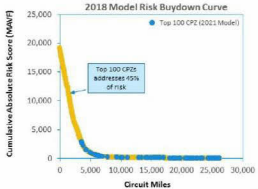
Action Items from 11/09/2020 (Federal Monitor Meeting)

Workstream	Action Item	Description	Responsible party	Resolution	Date
Risk Models	4-63 model's comparison WGS - 10/30/2020	Identify all risk areas outside of HTD [REDACTED] in the next iteration of the Dr. Model	[REDACTED]	Road Mapped - This will be added as an enhancement to the model roadmap	XXX
Risk Models	Risk Model Enhancement	Incorporate 2019 USGS data and species data in the next iteration of the Dr. Model	[REDACTED]	Road Mapped - This will be added as an enhancement to the model roadmap	XXX
Risk Models	Risk Model Enhancement	Include Egress on the consequence side for the next iteration of the Dr. Model	[REDACTED]	Road Mapped - This will be added as an enhancement to the model roadmap	XXX
Risk Models	Model Documentation	Julia to be added to charts on slide 72 (ppt 11.09.2020 Wildlife Risk Model Review Final 43)	[REDACTED]	Completed	XXX



Risk Model Action Items

Workstream	Action Item	Description	Responsible party	Resolution	Date
Risk Model	Risk Model Comparison WGR - 10/30/2020	Create risk comparison between the 2018 risk model and 2021 risk model to highlight movement of CPZs. The getting top 100 (circuits or CPZs)	[Redacted]	Complete - See the Risk Model Followup Section	11/3/2020



Key Takeaways

- No CPZs in the top 100 overlap
- This will result in significant change to the prioritization and expected risk buydown of mitigations
- The 2018 risk results were not distance weighted, where the 2021 prioritization included a distance factor.



Risk Model Action Items

Workstream	Action Item	Description	Responsible party	Resolution	Date
Risk Model	Deep dive risk model session WDR-15/16/2020	Hold a Deep Dive session with (1) the Federal Monitor and (2) the Operational Observer	[Redacted] to [Redacted] to be part of the meeting.	Complete - Meetings have been scheduled for 11/8 & 11/12	11/12/2020

Updates

- First Deep Dive session held on Monday 11/10/2020 at 1:00pm PST
- Second session will be held on Thursday 11/12/2020 at 12:30pm PST

Risk Model Action Items

Workstream	Action Item	Description	Responsible Party	Resolution	Date
risk models	risk model contributors	highlight contributors to the risk model	[REDACTED]	Complete - Targeted for inclusion in next release	11/12/2020

Vegetation Model - Contributors		Conductor Model - Contributors	
Variable	Permutation Importance	Variable	Permutation Importance
Tree height class	25.1	Non-burnable area	20.8
100 hour fuel class	24.1	Daily precipitation, mean	20.8
Vapor pressure deficit, avg	21.6	Conductor material: ACSX	9.7
Quality summer day pct	6	Estimated conductor age	8.9
Wilt	4.3	Max tree height	4.5
Area: urban-avg	3.1	Reliability program color	4.3
Impervious	2.8	Vapor pressure deficit, mean	4.0
Specific humidity, avg	2.4	Conductor size: 2	3.4
Rain: index-avg	3.3	Conductor size: 4	1.6
Windiness	1.9	100 hour fuel, mean	1.1
Temperature, avg	1.6	Max temperature, mean	1.0
Windy summer day pct	1	Wind speed, mean	0.5
Local topography	0.8	Local topography	0.2
Tree height, avg	0.8	Conductor size: 6	0.1
1000-hour fuel, avg	0.6	Conductor material: AL	-0.2
Emergence, avg	0.4	Conductor material: CU	-0.2

Key Takeaways

- Tree height and "Non-burnable area" are the most important variables in the vegetation and conductor models, respectively.
- Vegetation density had low predictive utility in the vegetation model, and was not included in the final design



Risk Model Action Items


Workstream	Action Item	Description	Responsible Party	Resolution	Date
risk model	risk model contributor	provide a detailed description of the top model contributors	[Redacted]	Complete - Targeted for inclusion in next release	11/13/2020

Vegetation Model - Contributors Description

Variable	Description
Tree height_max	Maximum tree height, in meters, from each 100m x 100m pixel area using the distribution grid
100-hour-fuel_wtg	The dead fuel moisture data from GRDMET
Vapor-pressure-deficit_wtg	The average vapor pressure deficit from the GRDMET dataset
Windy-summer-day_pct	Percentage of days that have high frequency of winds
WU	High fuel/moisture district
Precipitation_wtg	The average daily precipitation from the GRDMET dataset
Impervious	Impervious ground cover (i.e. non-flammable)
Specific-humidity_wtg	The average specific humidity from the GRDMET dataset
Burn index_wtg	An derived variable based off of the geographical and topographical aspects of a location
Wind_max	The maximum wind velocity at a height of 10 meters from the RealTime Mesoscale Analysis (RTMA) dataset at a resolution of 2.5km
Temperature_wtg	The average temperature from the GRDMET dataset
Windy-summer-day_pct	Percentage of days that have a high percentage of days with high average wind speed
Local-topography	The topographic position index (TPI) was extracted from a USGS digital elevation model (DEM) at 100-meter resolution
1000-hour-fuel_wtg	The dead fuel moisture data from GRDMET
Energy-release_wtg	Local topography

Conductor Model - Contributors Description

Variable	Description
Non-flammable-area	Land surface description similar to imperviousness that includes surfaces that typically don't ignite when a spark occurs
Daily-precipitation_mean	The average daily precipitation from the GRDMET dataset
Conductor material_area	Aluminum conductor steel-reinforced
Estimated-conductor-age	Number of years since the installation year
Max tree height	Maximum tree height, in meters, for each 100m x 100m pixel area using the distribution grid
Reliability Program score	Score with more than three calls per phase
Vapor pressure deficit_mean	The average vapor pressure deficit from the GRDMET dataset
Conductor size_2	Conductor size 2
Conductor size_4	Conductor size 4
100-hour-fuel_mean	The dead fuel moisture data from GRDMET
Max temperature_mean	The average maximum temperature from the GRDMET dataset
Wind speed_mean	The average wind velocity at a height of 10 meters from the RealTime Mesoscale Analysis (RTMA) dataset at a resolution of 2.5km
Local topography	The topographic position index (TPI) was extracted from a USGS digital elevation model (DEM) at 100-meter resolution

 **Risk Model Action Items**

Workstream	Action Item	Description	Responsible party	Resolution	Date
Risk Models	Model process documentation	Bring the Model Process Level Documentation to this forum for an official approval	[REDACTED]	In Process Targeted for inclusion in deep dive sessions	11/20/2020

1 User Guide
Model procedure and details will be provided in the user guide to the forum for review at the 11/20 session

Risk Model Action Items

Workstream	Action Item	Description	Responsible party	Resolution	Date
Risk Models	Protection zone selection criteria	Factor in Egress into process for selecting the protection zones to be worked	[REDACTED]	Reed Mapped - Egress has been considered and future enhancement for the risk model	11/05/2020

Factors around Egress

Analysis of the difficulty to access or evacuate communities. Egress analysis was based on:

- 1) Population density of communities
- 2) The number of roads for each community
 - Highways / Interstates
 - County roads
 - Residential roads

✓ Census data has been used as a proxy for calculation of population density of communities.

Plan for utilizing Egress

Need input from [REDACTED]

Key Takeaways

- REAX model uses census data for calculation of community population density. Ichnosylva incorporates more granular data for population density calculation
- External validations on the 2018 egress model highlighted a lack of predictive performance.

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Risk Model Action Items

Workstream	Action Item	Description	Responsible party	Resolution	Date
Wildfire Governance Charter	Charter update	Update charter to include review of broader set of WFP risk reduction activities and projects (see slide).	[REDACTED]	Completed. Risk Charter has been updated, included in attached materials.	11/05/2020

See updated slide for the updated wildfire governance Charter

Meeting Purpose:

- Drive decision making on:
 - Wildfire Governance Charter alignment on the top-level risk framework to guide the work, provide a focus to review key risk-based assumptions, and associated projects.
 - Work:
 - Review completion of the highest priority risk mitigation work completed with investments, asset, strategy and operational needs; guide actions as needed.
 - Discuss the approved work plans completed and the quality of the completed work is monitored.

Key Deliverables:

- Integrate individual wildfire mitigation action items into a single governance session
- Identify any issues on system hardware, operational expansion management, inspections and repairs and will expand into other areas of wildfire and PPS mitigation work
- Meeting topics and supporting material will adjust based on discussion and request from Working Directors.

Attendees:

- Chair: Chief Risk Officer
- Working Members:
 - VP Asset, Risk Management & Community Wildfire Safety Program
 - VP Major Projects and Programs, Electric Operations
 - VP Wildfire Safety and Public Engagement
- VP Chief Audit Officer

Resource Members:

- Sr. Director, Electric Asset Strategy
- Sr. Director, Major Programs & Project Delivery
- Sr. Director, Risk Management
- Director, CIP & M&P

Workstream Lead:

- System Hardware Director, Distribution Strategy
- Enhanced Inspection Management, Director, Regulatory Management
- Inspection & Repair Manager, Transmission Standards

Facilitator:

- Sr. Director, Risk - Special Projects

How Decisions are Made:

- Initial meeting agenda will be an addendum for decisions to be made
- A simple majority vote by attending committee members
- For broader: Chair hold the tie-break vote

Meeting Logistics:

- Frequency/Duration: Weekly (every Friday)
- Materials:
 - Pre-read materials sent 1 day before meeting
 - Action items included in following meeting material
- Agenda: Sr. Director, Risk - Special Projects to approve final agenda.

 Key Wildfire Risk Model Governance Forum Decision				
Workstream	Decision	Description	Approval Vote	Date
Risk Models	Adoption of the 2021 wildfire risk models for mitigation deployment	<ul style="list-style-type: none"> Adopt the approved ignition model for vegetation ignitions and Technology for 2021 PDM work Adopt the approved ignition model for equipment ignitions and Technology for 2021 System Rendering work 	<ul style="list-style-type: none"> Approved Approved Approved Not Present 	10/20/2020



Key Decision – Adoption of the 2021 Risk Model for Mitigation Deployment

Approval Status Approved

Decision Detail

The approval is for moving from the 2018 wildfire risk model to the 2021 wildfire risk model to inform system hardening, enhance vegetation management and inspections. These changes included:

- Update to vegetation ignition model (LoRe)
- Update to conductor model (LoRe)
- Update to consequence (core)

Concerns and Mitigations

- Inclusion of non-HFTD areas requested in the next model iteration
- Inclusion of Egress model requested in the next model iteration
- Resource availability to complete "hot risk informed planned work" was challenged
- Detailed description of variables in particular "non-burnable areas" requested
- The ability to calculate tree density within psweb was challenged

Approvals

Approved
Approved
Approved
Approved
Abstain – Not Present

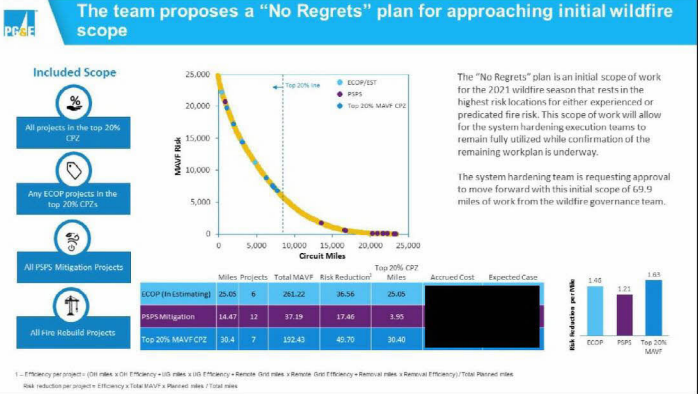
Action Items and Validations

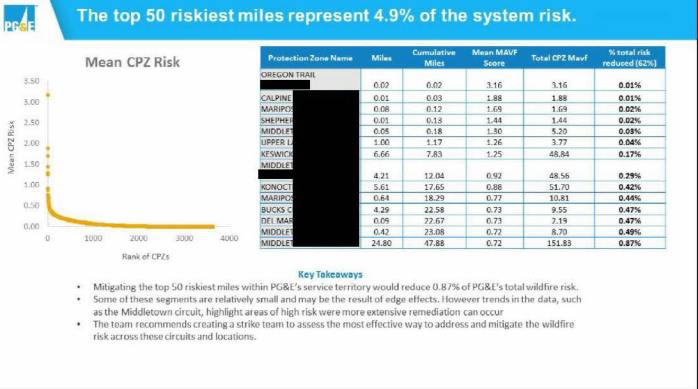
Adoption of the 2021 wildfire risk model for mitigation deployment Deep dive risk model session	Completed - Adopt the proposed ignition model for vegetation ignitions and Technosylva for 2021 DVM work Completed - Adopt the proposed ignition model for equipment ignitions and Technosylva for 2021 System Hardening work
Risk models comparison	Completed - Detailed risk comparison between the 2018 risk model and 2021 risk model to highlight improvement of CP2s (Targeting top 100 circuits or CP2s)
Deep dive risk model session	In Process - Hold a Deep Dive Session with (1) the Federal Monitor and (2) the Operational Closure
Model process documentation	In Process - Bring the Model Process Level Documentation to this forum for an official approval
Egress Consideration	In Process - Factor in Egress into process for selecting the protection zones to be worked

System Hardening



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The scope for the 2020 Rebuild is focused in XXXX

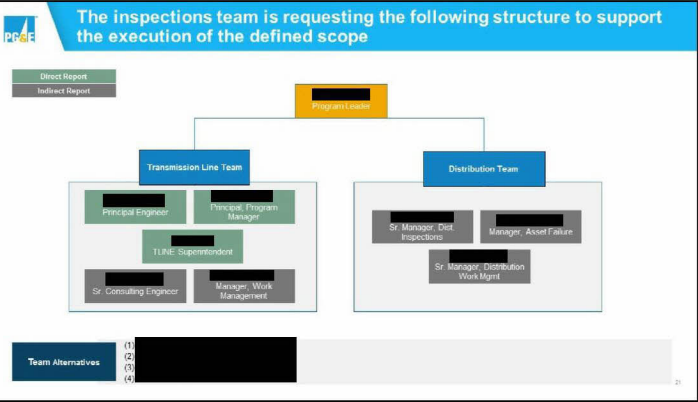
On a GIS Map and on a Tableau Dashboard – I can get [redacted]
[redacted] started on both once I have the order numbers.

Overhead Inspections



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Enhanced Vegetation Management

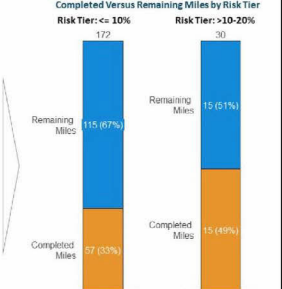


EVM is requesting approval to commence work on ~130 'no regret' miles involving a total of seven Circuit Protection Zones (CPZs)

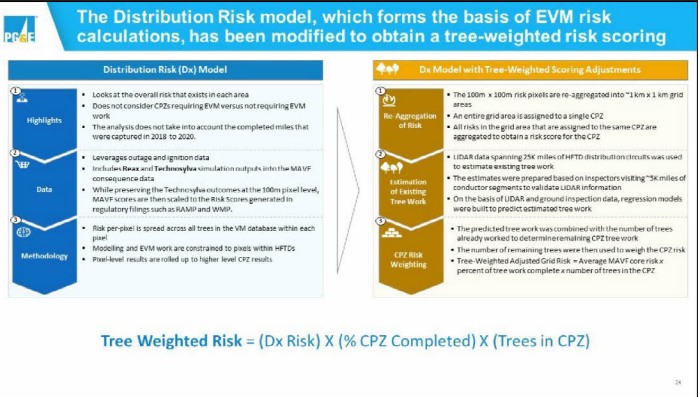
Circuit Protection Zones with 'No Regret' Remaining Miles

CPZ Name	Completed Miles	Total Remaining Miles	Estimated Tree work	Percent Complete
Oakhurst	16.18	27.50	2,137	37.0%
Middleton	4.78	11.40	1,046	29.5%
Fitch Mountain	0.15	20.60	3,240	0.7%
Garberville	0.58	4.84	2,471	10.7%
Bangor	15.53	26.69	2,587	36.8%
Tivy Valley	20.16	24.06	789	45.6%
Total	57.37	115.10	12,270	38.8%

CPZ Name	Completed Miles	Total Remaining Miles	Estimated Tree work	Percent Complete
Penryn 1103 Circuit Breaker	14.59	15.22	492	48.9%



While the full EVM 2021 work plan is being discussed, the EVM team seeks an approved scope for work starting in December that includes 130 miles prior to the approval of the full 2021 work plan



2021 EVM Highlights

Key Features and Scope Areas

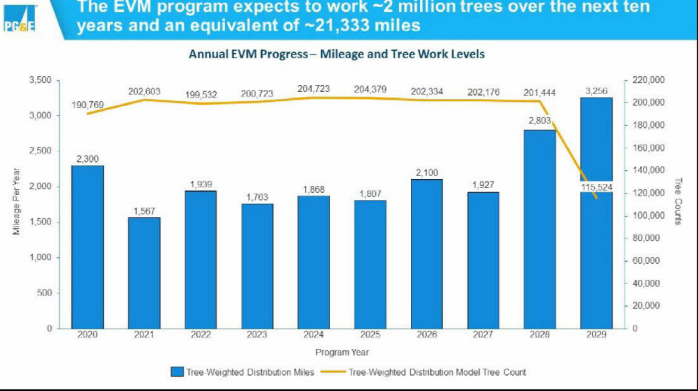
- Circuit Protection Zones (CPZs)**
 - The 2021 plan incorporates the concept of the CPZ – a term coined by the Asset Strategy team
 - CPZs are being used because they are tied to isolation devices on circuits, and in the case of PSPS events, indicate a way to isolate a circuit from a certain point
- Plan rationale**
 - The 2021 LVM plan has been prepared with the intent that:
 - The plan avoids any System Hardening projects in 2021
 - The plan focuses on CPZs that have between 60-90% completion in line with maintaining EVM scope within the routine program
 - Scope**
 - The plan targets ~190,000 trees and 2,100 miles of distribution circuits
 - The plan envisions a pre-inspection of between 831-904K trees, tree work of an estimated 159-195K trees and removal of an estimated 100-133K trees
 - The current plan has been prepared on the basis of a tree-based weighted analysis of risk across CPZs to take into account tree work already completed – a variable that is missing from the Dix model

Regional Distribution of Targeted Mileage (miles)

Region	Miles	Percentage
Bay Area	1,606	22%
Central Coast	949	13%
Central Valley	1,241	17%
North Coast	1,061	17%
North Valley	2,184	30%
Sierra	2,100	29%
Total	7,300	100%

Other Considerations

- Plan Inputs:** The plan has been prepared on the basis of work completed and risk from the VM Wildfire Risk Model
- The plan overlaps with inputs from local subject matter experts (SMEs), prior inspections and local customer/agency contacts
- Regions:** Plan targets have been balanced with respect to a 12 year plan across each of the regions
- Estimated cost:** A direct cost of [redacted] is estimated for pre-inspection and tree work spend
- CPZ Inclusion:** CPZs have been included on the basis of the following confidence levels:
 - CPZs where tree work has been 60 percent completed and have been identified for further LVM work
 - CPZs where more than 90 percent of the work has been completed are not targeted as there are other environmental or access issues that are the source of risk and cannot be mitigated by additional EVM work



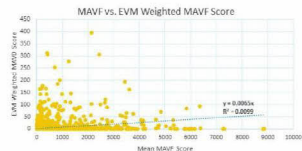


Comparison of the Tree Weighted model to the Dx Model



Key Take-aways

- The correlation between the EVM weighted prioritization scores and the MAVF score is low at 0.0099
- Of the top 20% of circuits that were identified in the Dx model, only 147 remained in the top two deciles of the Tree Weighted model.
- Of the top 100 CPZs, only 14 were common across both prioritization lists
- Over 10% of the CPZs identified to have risk in the Dx model were zero risk locations in the tree weighted model.




First 100 common CPZs

VACA OXON	AUBERRIE
AUBERRY 11	DISCHU
TINY VALLEY	COARSE
OREGON TR	TINY VAL
MADRIDIA	GAKHUK
SAND CREEK	RED BLUE
TINY VALLEY	ZACA 11

Action Items and Next Steps



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 Action Items					
Workstream	Action Item (Initial Date)	Description	Responsible Party	Resolution	Date
Enhanced Vegetation Management	FVM Risk Reduction Curve WGR - 11/1/2020	Plot and show the 120 miles 90-90% Carry Over Work that needs to be included on the DM - Q2 (Dens, Tree and Overhang (Weighted) Risk Reduction Curve	Support [Redacted]	In Process - Current scope is being plotted against the current risk laydown curve	11/19/2020
Enhanced Vegetation Management	FVM programs timeframes WGR - 11/1/2020	Determine the overall time frame and pace for the FVM programs when Stock Potential Trees are factored into the 23000 miles of W12 Groups Underland which of the 29500 miles need FVM work	[Redacted]	In Process - Dependent on prioritization decision	11/26/2020
Enhanced Vegetation Management	FVM programs and roadwork WGR - 11/1/2020	Provide a full picture of all vegetation management work, outside of just the enhanced vegetation management.	[Redacted]	In Process - Review of other programs underway	11/26/2020
Enhanced Vegetation Management	System hardening and FVM work overlay WGR - 11/2/2020	Evaluate the areas that are being targeted by system hardening to align for operational efficiencies between the two programs. Dependency on 2021 SR Work Plan	[Redacted]	In Process - Current scoping apparatus not have operational efficiencies with hardening	Dependent on SR plan
Enhanced Vegetation Management	Tree density statistic WGR - 11/1/2020	Show Tree Density from the 2018 and 2020 Work. Provide tree density number per mile processed as we show future work 2021, 2022	Support [Redacted]	Road Mapped - UTM tree density will be examined for inclusion in future risk modeling	TBD

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Action Items (Cont'd)


Workstream	Action Item	Description	Responsible Party	Resolution	Date
Risk Models	Risk models comparison WGR - 10/30/2020	Create risk comparison between the 2018 risk model and 2021 risk model to highlight movement of CRs (Targeting top 100 in units w/ EFS).	[REDACTED]	Completed	11/11/2020
Risk Models	Deep dive risk model session WGR - 10/30/2020	Hold a Deep Dive Session with (1) the Federal Monitor and (2) the Operational Observer.	[REDACTED] to be part of the meeting	Completed	11/11/2020
Risk Models	Risk model contributors	Highlight contributors to the risk model.	[REDACTED]	Completed	11/11/2020
Risk Models	Model process documentation	Bring the Model Process doc to documentation to this for use for an official approval.	[REDACTED]	In Process - Targeted for inclusion in deep dive sessions.	11/20/2020
Risk Models	Egress Consideration	Factor in Egress into process for selecting the protection zones to be worked.	[REDACTED]	Road Mapped - Egress has been considered as a future enhancement for the risk model.	11/09/2020
Offshore governance Charter	Charter update	Update charter to include review of broader set of WP risk reduction activities and project oversight.	[REDACTED]	Complete Risk charter has been updated. Included in attached materials.	11/09/2020



Action Items from 11/09/2020 (Federal Monitor Meeting)

Workstream	Action Item	Description	Responsible Party	Resolution	Date
Risk Models	Risk Models comparison WGR: 10/30/2020	Include high risk areas outside of MFD in the next iteration of the Du Model	[Redacted]	Road Mapped - This will be added as an enhancement to the model roadmap	11/23/20
Risk Models	Risk Model Enhancement	Incorporate 2019 LIDAR data and species data in the next iteration of the Du Model	[Redacted]	Road Mapped - This will be added as an enhancement to the model roadmap	11/23/20
Risk Models	Risk Model Enhancement	Include signs on the consequence side for the next iteration of the Du Model	[Redacted]	Road Mapped - This will be added as an enhancement to the model roadmap	11/23/20
Risk Models	Model Documentation	Acas to be added to charters alpha 22 Sept 11.09.2020 Wildlife Risk Model Review Final v3	[Redacted]	Completed	11/23/20

 Past Action items					
Workstream	Action Item	Description	Responsible party	Resolution	Date
Inspection	Inspection Workstream Owner	Schedule meeting to identify the owner of the inspection and/or repair workstream		Completed – inspection lead identified	10/21/2020
Risk model	Risk Model Deep Dive	The risk model needed further detailed discussion before voting and approval could take place		Completed – Follow up session held 10/27. Detail on the risk model was provided in advance of 10/30 approval meeting.	10/23/2020
RIM	RIM review meeting	Schedule additional meeting for RIM review		Completed – Follow up meeting was held on 11/05	11/05/2020
Governance meetings	Meeting updates	Update meeting to be 90 minutes		Completed – future meetings updated – effective 11/13	11/05/2020
Governance meetings	Add [redacted] to future meetings	[redacted] to be added to future meetings to provide additional direction from audit		Completed – [redacted] has been added to all future governance meetings	10/23/2020

 **Upcoming Review Agenda Items**

11/20/2020

- Final Decision on System Hardening Plan (If feasible)
- Initial Review into Inspections 2021 Plan
- Initial Review into Repairs 2021 Plan
- Close out Completed Action Items

12/01/2020

- Final Decision on EVM 2021 Plan (If feasible)
- Decision Items needed for Inspections and Repairs 2021 Work Plan
- Close out Completed Action Items

12/08/2020


- TBD

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Appendix



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 Key Wildfire Risk Model Governance Forum Decision				
Workstream	Decision	Description	Approval Note	Date
Risk Models	Adoption of the 2021 wildfire risk models for mitigation deployment	<ul style="list-style-type: none"> Adopt the approved ignition model for vegetation ignitions and Technology for 2021 PDM work Adopt the approved ignition model for equipment ignitions and Technology for 2021 System Rendering work 	<ul style="list-style-type: none"> Approved Approved Approved Not Present 	10/20/2020

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Key Decision – Adoption of the 2021 Risk Model for Mitigation Deployment

Approval Status Approved

Decision Detail

The approval is for moving from the 2018 wildfire risk model to the 2021 wildfire risk model to inform system hardening, enhance vegetation management and inspections. These changes included:

- Update to vegetation ignition model (LoRe)
- Update to conductor model (LoRe)
- Update to consequence (core)

Concerns and Mitigations

- Inclusion of non-447D areas requested in the next model iteration
- Inclusion of Egress model requested in the next model iteration
- Resource availability to complete "hot risk informed planned work" was challenged
- Detailed description of variables in particular "non-burnable areas" requested
- The ability to calculate tree density within pswh was challenged

Approvals

Approved
Approved
Approved
Approved
Abstain – Not Present

Action Items and Validations

Adoption of the 2021 wildfire risk model for mitigation deployment Deep dive risk model session	Completed - Adopt the proposed ignition model for vegetation ignitions and Technosylva for 2021. OVM work
Risk models comparison	Completed - Detailed risk comparison between the 2018 risk model and 2021 risk model to highlight improvement of CP2s (Targeting top 100 circuits or CP2s)
Deep dive risk model session	In Process - Hold a Deep Dive Session with (1) the Federal Monitor and (2) the Operational Closure
Model process documentation	In Process - Bring the Model Process Level Documentation to this forum for an official approval
Egress Consideration	In Process - Factor in Egress into process for selecting the protection zones to be worked