1. MEETING MINUTES

The minutes are organized by topic per the agenda.

1.1 INTRODUCTIONS (MELISSA LINEBERGER, COE DIRECTOR)

Melissa Lineberger and Brad Schmidt (CoE) opened the meeting by thanking everyone for attending and participating.

1.2 MEETING GOALS AND OBJECTIVES (COE AND NCAR)

Brad Schmidt reviewed the goals and objective of the meeting, which are primarily to present CAWFE® model capabilities and verification results and seek feedback on the desired features and functions of the CO-FPS.

1.3 REVIEW OF STAKEHOLDER FEEDBACK FROM DECEMBER MEETING (COE)

Discussion notes and stakeholder feedback are captured below. Adam Trojanowski (CoE) gave an overview presentation on the main themes that emerged from the first Stakeholder Meeting that was held on 3 December 2015.

- The primary feedback themes of the first stakeholder meeting included:
  - *System and Data Accessibility* - access in the field, remote areas, different platforms
  - *Ease of Use* – Interface can't be too complicated and must be user-friendly or it won't be used; may have different levels of users with different experience
  - *Adjustability and Adaptability* - user-based observation feedback; run different scenarios and resolutions; first guess versus more detailed runs
  - *Smoke & Air Quality* – can this tool help in smoke estimation and decision making?
  - *Validation* - compare CO-FPS to reality in real-time and off-line. Also measurehow it compares to the current tools?
- Stakeholders also indicated that they wanted to better understand the type of wildfires the system will be best suited for, such as larger versus small fires.
- Stakeholders also want to be able to adjust input data such as fuel information to make sure CO-FPS has the latest information.
- Stakeholders also wanted the output to be usable for users beyond fire behavior analysts.

1.4 Introduction to CAWFE® verification cases vs. current tools (NCAR)

Bill Mahoney (NCAR) presented information on the CAWFE® model and presented verification information for several historical fire cases including some results on how the system performed compared to current tools such as FARSITE and Near-Term Fire Behavior (NTFB) tool.

The slides have been provided to the CoE for posting.

Questions raised during the presentation are listed below along with the questions raised during the "discussion" sessions.

1.5 Discussion - Review of current practices (NCAR + CoE facilitate)

During and following the presentations by Bill Mahoney, members of the audience posed several questions. Stakeholder questions captured during the meeting are provided. The initial responses discussed at the meeting (paraphrased) are provided below each question in blue text.

- How will CO-FPS compare and be used with current tools?
  - NCAR Response: The CO-FPS products will be labeled "experimental" during the development stages of the project while the system is being developed and refined. The CO-FPS products are an additional tool that should complement current tools. For small fires where the fires do not significantly influence the local weather, the differences between the current tools and the CO-FPS may not be large.
- It will be important to perform case studies to compare CO-FPS products to current tools and develop guidance on how the tools should be used for a variety of situations.
  - NCAR Response: NCAR agrees that the analysis of case studies and verification will be an important aspect of the project as it progresses.
- How will thunderstorms be created in the model?
  - NCAR Response: The CAWFE® model and the larger scale model that provides its boundary conditions include the full atmosphere covering the surface to upper levels (above the jet stream). If the conditions exist for thunderstorms to form, the models should capture them. If the fire is forming in an atmosphere that is conducive to pyro-cumulus cloud formation, then that phenomena should also be predicted.
- What fuel sources will be going into the model?
  - NCAR Response: For the initial operating capability (IOC - year 1), the CO-FPS will use LANDFIRE data. It is recognized that there is a desire for a fuel dataset this is regularly updated and current. Discussions will continue with the CoE on how to deal with this topic. NCAR will design the CO-FPS to be able to ingest and utilize a more "current" fuels database when it becomes available.

- What will the model do if there is no local fire-line data fed back in before the next model cycle?
    - NCAR Response: If the model is configured to do an automatic update and it has no new fuel or fire spread information, the model will default to using the model generated fuel line as its new starting point. Updated fire line information from the field will ultimately improve subsequent model runs.

1.6 Review of CO-FPS fire behavior prediction products (NCAR)

Bill Mahoney presented information on the flow of data and the generation of the fire weather, aviation hazard, and fire behavior products from CO-FPS and described a variety of options of how the information could be provided to CO-WIMS.

- How often will output be available from the CO-FPS?
    - NCAR Response: The system can be configured to generate its forecast output in time increments that range from minutes to several hours. We don't want to overwhelm the users with too much information. Feedback suggests we should provide hourly output for the first 3 hours of the forecast period and then every three hours thereafter out to 18-hours.
- Is any forecast confidence information generated from the system?
    - NCAR Response: In the IOC system, one can only glean confidence information by observing how similar the output is from each model cycle. The more similar the output is between model runs, the more likely the conditions are predictable and not too sensitive to uncertainties in the initial conditions. In later versions of the CO-FPS, we would like to use multiple model runs valid at the same time (an ensemble of models) with varying initial weather and fuel conditions to create a probabilistic product.
- Was there any CAWFE® model bias in the High Park fire?
    - NCAR Response: The model did get the general progression of the fire well, but the modeled fire lines lagged the actual fire line by a couple kilometers as was shown in slide #6. It wasn't clear what caused the lag in the model. A stakeholder mentioned the faster progression could have been from spotting from flying embers. The current CAWFE® model does not calculate spotting whereby embers are blown downwind and ignite fires.
- How do you measure the fire perimeter since it can be measured by hand walking the fire or from an image?
    - NCAR Response: The fire perimeter (flaming front) data sources can include the MMA, orbiting satellite sources (e.g., VIIRS), and/or hand created datasets. The data will be provided to CO-FPS through CO-WIMS.
- Does CAWFE predict spotting?

- NCAR Response: The current CAWFE® model does not currently calculate spotting whereby embers are blown downwind and ignite fires.

1.7 What are the priorities for the fire behavior prediction products and critical functionality? (NCAR)

This discussion session began with asking the Stakeholders about the pros and cons of the current tools and how they are used. The Stakeholders indicated the following:

- There is a sense that the initial predictions from the current tools are going to be insufficient until more information about the fire becomes available. The new information can then be used to manually refine the inputs in the current tools.
- A stakeholder noted that "FSPro takes a lot of time to set up and run, so it needs to be worth it."
- A concern was raised that the fuel datasets are generally out of date and do not include current information. Stakeholders can manually override the fuels data when setting up a current model run. The stakeholders would like a process whereby recently collected fuel data can be integrated into a traditional fuels database such as LANDFIRE to create a more dynamic and accurate capability.
- Several stakeholders indicated that some fire risk and stability indices (e.g., NFDRS, Haines, etc.) are calculated manually from disparate datasets and it would be helpful if CO-FPS could calculate them automatically if the data are available to do so.
- What fire behaviors are important to capture in the system? The feedback was:
  - Wind shifts
  - Pyro-cumulus
  - Horizontal vortices or roles
  - Column collapse
  - Gustiness
  - Flame bursts
  - Fire Whirls
  - Plume-weather interactions
- A stakeholder then asked whether NCAR could create products that indicate likelihood of extreme fire behavior events relative to climatology.
  - NCAR Response: This is something we will keep in mind as CO-FPS is developed.
- The stakeholders were asked about whether the CO-FPS should generate alerts or other heads-up messages when the likelihood for specific critical phenomena are predicted. The stakeholder response was:
  - Yes, an alerting type feature would likely be useful
  - Event type and thresholds would need to be determined and refined based on future user feedback

- Where in the system are alerts and advisories computed?
    - NCAR Response: The calculations could be done within the CO-FPS or possibly CO-WIMS depending on where the data reside. To reduce the need for sending copious amounts of atmospheric data to CO-WIMS, we will lean toward performing calculations or derived products within CO-FPS.
- Can we create a 'Bucky's Bad Day' index map that could be displayed on CO-WIMS?
    - NCAR Response: It's certainly possible if CO-FPS has the data fields required to do the computation. The CO-FPS could then send the output to CO-WIMS for display. The product would really be a probability metric. More information will need to be collected later to define this product.
- A stakeholder asked whether they could use the CO-FPS products in some way to help with staffing levels to get a sense when the fire "will lie down a little" for example.
    - NCAR Response: This is a valid use case and the fire behavior and atmospheric output types should be available to support this type of decision making once confidence in the products is built up.
- Will CAWFE® be able to simulate fire behavior at night and capture the differences from daytime?
    - NCAR Response: The CO-FPS system model – CAWFE®- includes a full atmospheric model that simulates the diurnal cycle, so all the typical things that happen at night (e.g., loss of solar radiation, increased humidity, lower air temperatures, increased stability, etc.) are part of the model.
- Stakeholders indicated that the National Weather Service (NWS) takes 1/2 hour or more to give them a spot forecast; but as a first cut, 1/2 hour is OK. There was a comment that an hour was even OK, but it depends on the user. Resource planners could handle an even longer delay.
    - NCAR Response: The CO-FPS will contain data that could be used to generate "spot" forecasts with the click of a button for any place in the state. That being said, there is value in having a NWS Incident Meteorologist in the loop to refine and add value to the product. The IMETs should also be provided access to the CO-FPS products so they can have another tool to support their forecasting process.
- Stakeholders indicated that there might be a need for a quick snap-shot of the fire behavior initially to start the attack planning process - this would be a huge improvement over the current situation.
    - NCAR Response: The speed at which the CO-FPS will generate its output is largely a function of computer speed and CAWFE® model resolution. We are targeting having the 18-hour forecast completed in less than 30 minutes from model trigger time. We will also output products as the model completes the forecast period, so earlier forecast products (e.g., first few hours of the forecast period) should be available sooner.
- How will on-site observations be added into the system?

- NCAR Response: CO-FPS will take advantage of thousands of in-situ and remotely sensed observations that are assimilated into the NWS's High-Resolution Rapid Refresh (HRRR) weather prediction model, which will provide the boundary conditions for CAWFE®, and eventually we will want to investigate the value of directly assimilating special observations directly into CAWFE® over the fire model domains. It should be noted that when only a few observations are assimilated into a weather model they don't have a lasting impact in space and time as the data advects away quickly from the observation location. However, this topic will be worth exploring as the project progresses.

- Stakeholder feedback also suggested that the some CO-FPS products need to be made available to dispatchers. Some users will want to gain access to pre-generated products (e.g., .pdf graphics) via cell phones, tablets, laptops, and field printers.
  - NCAR Response: It should be technically feasible to create and disseminate selected products in formats that lend themselves to the devices mentioned above.
- What happens if CO-FPS products conflict with other products?
  - NCAR Response: The CO-FPS products will be labeled as "experimental" while under development and refinement and until they are designated ready for operational use by the DFPC. The products will be another tool and will complement existing products. Like all prediction products, there will be times when there is disagreement between the various information sources.
- Stakeholders indicated that a forecast period of at least than 24 hours is desired to cover the decision period through the next full active fire day. A useful forecast period of 36 hours is probably ideal if the forecast skill does not fall away too quickly.
  - NCAR Response: The desire for a longer forecast period is appreciated and we will consider a system design that supports a longer prediction period. This will be something to tackle after the first development year. A probabilistic prediction approach is better suited for longer forecast periods since it can help address forecast uncertainty.
- Will the CAWFE® model automatically update itself every 3 hours or will the users need to intervene.
  - NCAR Response: This is still an active initial operating capability design question. In some cases, there will be no need for the model to run multiple cycles if the fire is under control and no additional guidance is needed. This could waste valuable computational resources that could be used for other fire predictions. In some cases, an auto-update process may be desired. We will continue to discuss options for this feature with end users.
- What input will be used to trigger a CAWFE® run?
  - NCAR Response: The basic input will include, date, time, location (LAT, LON), fire perimeter points, and fire ID. NCAR will be developing an Interface Control

Document (ICD) between now and April that will define the inputs and outputs between CO-FPS and CO-WIMS.

1.8 CLOSING REMARKS AND WRAP-UP (COE)

Brad and Melissa thanked the stakeholders for attending and actively participating in the discussion.

Brad announced that the next Stakeholder Meeting will be held on **Tuesday, 23 February, from 2-5PM at the Department of Public Safety, 9195 East Mineral Ave, Centennial, CO**

Appendix A – Meeting Agenda

COLORADO
Division of Fire Prevention & Control
Department of Public Safety

Center of Excellence for Advanced Technology Aerial Firefighting

Colorado Fire Prediction System January Meeting Agenda
January 26, 2016: 1 p.m. - 5 p.m.

1:00 p.m. - 1:15 p.m. Introductions

1:15 p.m. - 1:30 p.m. Meeting goals and objectives

1:30 p.m. - 1:45 p.m. Review of stakeholder feedback from December meeting

1:45 p.m. - 2:30 p.m. Introduction of research comparing CAWFE® accuracy to other current decision support systems

2:30 p.m. - 3:15 p.m. Discussion on current fire behavior analysis practices

3:15 p.m. - 3:30 p.m. Break

3:30 p.m. - 3:45 p.m. Review of CO-FPS fire behavior prediction products

3:45 p.m. - 4:45 p.m. Discussion on priorities for CO-FPS fire behavior prediction products and critical CO-FPS functionality

4:45 p.m. - 5:00 p.m. Closing remarks and wrap-up