USING FIRE DANGER PRODUCTS TO MANAGE READINESS, RISK, AND RESPONSE DECISIONS

Contents

OBJECTIVE(S)

Upon completion of this lesson, participants will be able to:

1. Understand basic principles of decision-making and risk.
2. Provide examples of how the fire danger management tools can optimize the potential outcome of a decision by minimizing the associated risk.
3. Describe how the fire danger management tools support risk management.

NARRATIVE

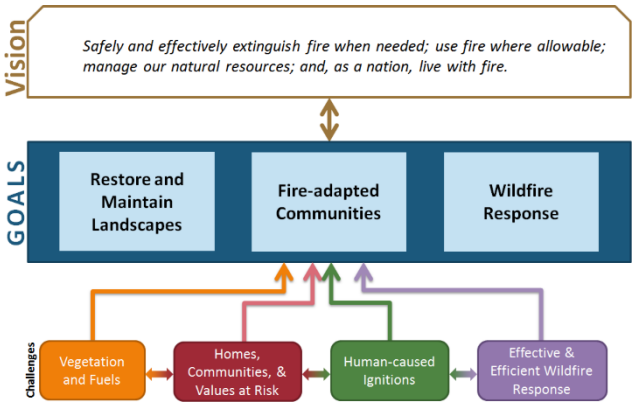
I. INTRODUCTION

Why do we use the National Fire Danger Rating System (NFDRS)?

A. Vision of Wildfire Response

A core value for the wildland fire community is all jurisdictions participate in making and implementing safe, effective, efficient risk-based wildland fire management decisions (Wildland Fire Leadership Council, 2014).

The Wildland Fire Leadership Council (WFLC) adopted the following vision for the next century:



"Wildfire response: All jurisdictions participate in making and implementing safe, effective, efficient risk-based wildfire management decisions"

The National Fire Danger Rating System (NFDRS) provides a consistent framework, in a complex, interagency environment for situational awareness, wildfire response, fire restrictions and fire prevention decisions. Generally, the decisions supported by the NFDRS can be summarized in three categories:

1. Protecting communities

Wildland fire is dynamic and respects no jurisdictional boundaries. No single agency can manage and respond to all wildland fire threats. To protect our cities, towns and villages, we must work together across all levels of our organizations to respond to wildfire ignitions. Utilizing NFDRS to implement

informed decisions in responding to wildland fire enables us to be more effective in our response and leverage resources with our partners.

2. Managing the land

   Fulfilling objectives in land management plans calls for making mindful decisions on the time, place and environmental conditions to allow fire to move across the landscape. This will lead to restoring ecosystems while managing short term risk to communities and reducing long term risks.

   Long term gains can be made in reducing wildfire risk to communities. One part of reducing long term risk is allowing good fire to reduce hazardous fuels and help create a resilient landscape.

3. People

   Understanding fuel moisture and weather conditions enable firefighters to make strategic decisions on engaging the fire. A constant awareness if your window is opening or closing as the day and season progress will allow firefighters to make mindful decisions on the fire line.

II. OVERVIEW OF DECISION-MAKING AND RISK

With respect to protecting communities, managing the land, and people:

A. What makes a *good* decision "good" and a *bad* decision "bad"?

   Caution: Do not evaluate a decision entirely on the outcome.

   1. Looking at the process of making the decision may be more valuable that the outcome.

   2. The outcome(s) of a decision will often occur over an indeterminant period of time; day, weeks, months, or sometimes years, making it difficult (or even impossible) to determine all the decision's outcomes.

   3. In addition, decision outcomes are driven by many factors outside of the decision-maker's control. After a decision is made, and before the outcomes occur, numerous factors -- outside the individual's control -- could influence the outcome(s).

III. DECISION-MAKING: A CLOSER LOOK

A. Everyday Subconscious Decisions

   Consider the decisions that are made by people every day, in everyday tasks while shopping, driving, working or just walking down a busy street. Some estimate that while humans make up to 35,000 decisions a day (Daum, 2012), a few decisions are deliberate / thoughtful, but the vast majority are made at varying levels of sub-consciousness (Sahakian & Labuzetta, 2013).

1. Words

   University of Texas researchers found that we use an average of 16,000 words a day (Swaminathan, 2007). Most of these words are selected subconsciously–but selected nonetheless (Mehl, Vazire, Ramírez-Esparza, Slatcher, & Pennebaker, 2007).

2. Driving

   The U.S. Occupational Safety and Health Administration (OSHA) reports that "drivers make more than 200 decisions during every mile traveled," so simply driving 20 miles a day adds considerably to the number of decisions made each day (OSHA, 2016).

3. Food

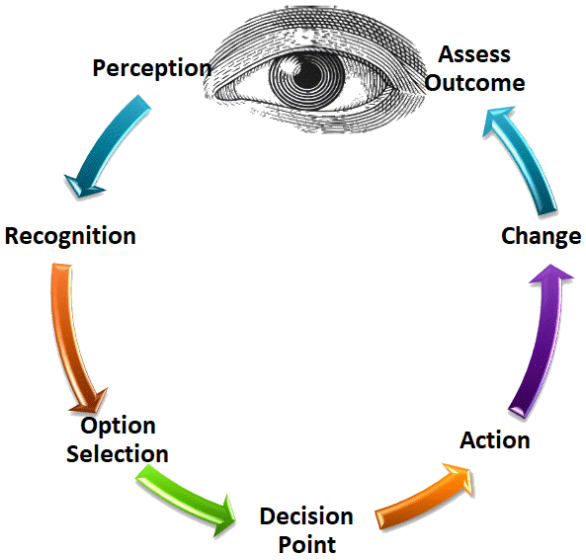
   Researchers found that adults make 221 decisions just on their food intake each day, and concluded, "First, we are aware of only a fraction of the food decisions we make. Second, we are either unaware of how our environment influences these decisions or we are unwilling to acknowledge it." (Wansink & Sobal, 2007).

   The sum of just these three activities is over 20,221 decisions each day. Decisions about physical movement, work, social relations, all add to this number, making Daum's estimate of 35,000 decisions a day conceivable.

Decision-making Cycle

Consciously or subconsciously, people go through a decision-making cycle EVERY TIME a decision is made.

Situational Awareness is how well a person's perception matches reality. If one's situational awareness is high, he or she has an accurate perception of reality.



Recognition means that a person determines that something needs to be done, that the environment must be changed in some way.

Option Selection involves understanding the factors and risks associated with various courses of action.

At the **Decision Point**, the best option is selected.

Action means acting on the selected option then returning to the situation awareness cycle—perceiving and gathering information— to assess the results of the action.

Graphic Adapted From: *Leading in the Wildland Fire Service* (PMS 494-2).

B. Recalling Lessons Learned from Tragedy Fires

1. Mann Gulch (13 Fatalities), August 5, 1949

On August 5, 1949, a wildfire overran 16 firefighters in Mann Gulch on the Helena National Forest in Montana. Only three survived—the foreman and two members of an 18-man smokejumper crew that had parachuted into a small valley or gulch near the fire. These deaths were a shocking loss to the firefighters' families and friends. The tragedy was also a severe blow to the Forest Service, which had not experienced a fatality during a decade of smoke jumping and was extremely proud of its elite firefighters. Repercussions from this incident were severe and long lasting.

a. Temperatures that day reached 97° F in Helena (Mann Gulch was 20 miles north of Helena)

b. In Helena, the wind had been blowing from the north and east at 6 to 8 mi/h that afternoon. At 3:30 p.m. the wind switched to the south, increased to 24 mi/h, and continued to blow strongly from the south at 14 to 22 mi/h.

c. At about 5 p.m. Canyon Ferry District Ranger Robert Jansson had reached the mouth of Mann Gulch by boat and was attempting to walk up the gulch to reach the smokejumpers. He estimated the wind at Mann Gulch to be between 20 and 30 mi/h with gusts to 40 mi/h.

d. The moisture content of fine dead fuels during the hottest part of the day was calculated from the temperature and humidity to have been about 3.5 percent.

2. South Canyon Fire (14 Fatalities), July 6, 1994

On July 6, 1994, the South Canyon Fire resulted in the deaths of 14 firefighters in Colorado. Following issuance of the South Canyon Investigation Report (Interagency Accident Investigation Team, 1994), the Director of the Bureau of Land Management and the Chief of the Forest Service established an Interagency Management Review Team (IMRT). Among the team's tasks was to identify significant issues and concerns related to interagency wildland fire management programs and recommend ways to address these issues and concerns. The recommendations in the IMRT report included application of NFDRS to "improve the way agencies predict fire danger by making the danger rating systems more understandable and easier to use, and then train people in how to use these systems and interpret the results." (Interagency Management Review Team, 1995)

a. Western Colorado was experiencing severe drought; Precipitation levels at Glenwood Springs from October 1, 1993, through July 6, 1994, were 58 percent of normal.

b. Foliar moisture in under-burned Gambel oak was about 60 percent while that in green unburned Gambel oak was 125 percent.

c. Colorado experienced record high temperatures during June of 1994.

d. The burning index in early July was at the highest level ever recorded for those days in the 21 years of weather records at the Colorado National Monument

3. Thirtymile Fire (4 Fatalities, 16 Entrapments), July 10, 2001

   On July 10, 2001, four firefighters lost their lives on the Thirtymile Fire in Washington. The Thirtymile tragedy prompted an Accident Prevention Plan which contained specific actions to enhance firefighter safety, including the need to identify thresholds for critical fuels and weather conditions that lead to extreme burning conditions and publishing these on pocket cards for use by firefighters.

   a. The Okanogan-Wenatchee National Forest was experiencing prolonged drought.

   b. Fuel moisture levels were at or approaching historic lows

   c. 1,000-hour fuel moisture was 10%

   d. Live fuel moisture was less than 100%

   e. The energy release component (ERC) was near the historic high for early July

4. Cramer Fire (2 Fatalities), July 22, 2003

   On July 22, 2003, two firefighters lost their lives in the Cramer Fire in central Idaho. OSHA levied serious violations which included the failure to recognize fire danger thresholds for large fires and respond accordingly. In addition, a remote automated weather station (RAWS) near the fire had not received maintenance and calibration before the start of the fire season.

   NFDRS weather stations must comply with the NWCG standards identified in the Interagency Wildland Fire Weather Station Standards and Guidelines (PMS 426-3). A program of annual (+/- 45 days from installation or previous year's maintenance date) RAWS maintenance/calibration is required. Every NFDRS RAWS must receive, at a minimum, one annual onsite maintenance visit by either the local user or contracted personnel to ensure sensors are within calibration standards and verify site and station conditions.

   The Skull Gulch RAWS site is the most representative of the Cramer Fire area, but weather data from this site was inaccurate and unusable due to a

temperature and relative humidity sensor that was not functioning properly as well as other weather data being reported erroneously.

a. The BIs and ERCs were near the high-end — the Forest BI was well above the 90th percentile and the ERC was at the 96th percentile-indicating dangerous conditions.

b. The burning index (BI), energy release components (ERC), and percent live fuel moisture were all comparable to the severe levels experienced during the 1988 Yellowstone Fires as well as the 2000 Clear Creek Fire in the Salmon-Challis Forest which made a 23,000-acre run in one day.

c. A crew on the Cramer Fire had reviewed their Pocket Cards a few days prior to the Cramer Fire and recognized that they were at conditions comparable to those on the Clear Creek Fire in 2000 that burned 217,000 acres

5. Yarnell Hill Fire (19 Fatalities), June 30, 2013

Conditions leading up to the Yarnell Hill Fire consisted of very high to extreme fire danger and extreme drought during a transition to the Southwest's summer monsoon season. During this seasonal transition, temperatures are typically very hot. Relative humidity values remain low but fluctuate as storms become more numerous and cloud cover more prevalent. Winds are highly variable with the highest wind speeds occurring during thunderstorms. These storms can generate strong downdrafts, micro-bursts, outflows, and gust fronts, all of which can affect fire behavior.

The Southwest Coordination Center's Predictive Services issued a Fire Behavior Advisory on June 16, 2013 that discussed critically low fuel moistures and increased fuel loading. On June 25, the National Weather Service (NWS) office in Flagstaff issued an excessive heat watch for Yavapai and northern Gila counties below 4000 feet.

C. Decision-Making Cycle: Revisited

When discussing how NFDRS relates to lessons learned from historical tragedy fires we tend to initially focus on the moment of, or shortly before, the catastrophic impacts to firefighters. The relationship with NFDRS and tragedy fires begins before the fire has started. Fire danger relates to the fire weather and fuels conditions leading up to the tragic event. It is essential to help people understand ***how*** to interpret daily NFDRS outputs and ***why*** it is important when assessing risk and making decisions.

1. Perception

a. How was fire danger perceived and discussed at the local unit?

b. Was fire danger discussed at the morning crew briefing?

c. Were initial response levels, staffing levels, adjective levels, preparedness levels discussed with local suppression resources, duty officers, fire managers, agency administrators?

d. Were response and staffing levels for the day determined and shared with local unit resources?

2. Recognition

a. Were fire danger indices/outputs recognized?

b. The start date for this fire was at peak fire season for this area.

c. Were local IA resources, fire managers, agency administrators aware of the fire danger indicators?

3. Option Selection

a. Did the local Duty Officer/Fire Manager understand what risks were associated with the fire danger variables?

b. Were course of action options identified and discussed with local suppression resources, dispatch centers, duty officers, fire managers, agency administrators?

(1) Were action items associated with calculated fire danger levels, as described in subordinate FDOP plans, referred to in the decision-making process?

(2) Were risks associated with fire danger identified and discussed with local suppression resources?

4. Decision Point

a. With respect to fire danger, what initial response/attack options were identified and discussed with suppression resources, dispatch, and duty officers/fire managers?

b. Did suppression resources, dispatch, and duty officers/fire managers understand ***why*** the preferred course of action was decided on?

5. Action

a. Were the initial attack actions based on an identified, preferred option that encouraged a persistent assessment of situational awareness?

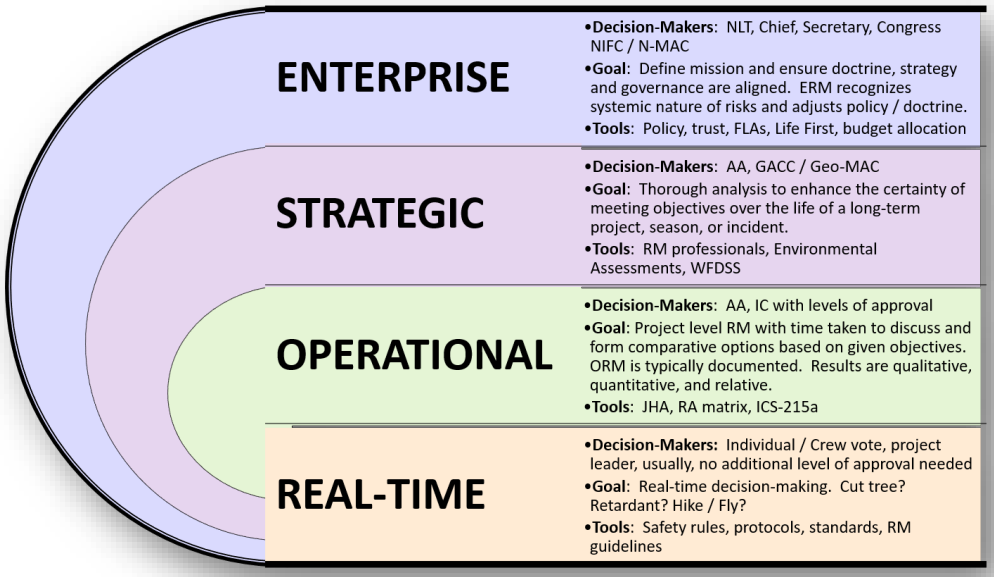
b. Did selected action(s) consider the complexities associated with a changing fire danger environment (i.e. consider changes in various

weather and fuels factors as the day progresses from early burn period to peak burn period).

c. Was fire danger associated with potential fire behavior considerations?

D. Organizational Decision-Making Influences

A decision made at any level of the fire management organization can influence another decision at any other level. Enterprise and Strategic decision-makers must understand that their communication to ground-level fire suppression personnel (directly or indirectly) can influence their decisions either positively or negatively. The outcome of real-time decisions made at the ground-level has the potential to influence the decisions at higher levels.



1. Enterprise -

Decision-Makers: NLT, Chief, Secretary, Congress NIFC / N-MAC

Goal: Define mission and ensure doctrine, strategy and governance are aligned. ERM recognizes systemic nature of risks and adjusts policy / doctrine.

Tools: Policy, trust, FLAs, Life First, budget allocation

2. Strategic

Decision-Makers: AA, GACC / Geo-MAC

Goal: Thorough analysis to enhance the certainty of meeting objectives over the life of a long-term project, season, or incident.

Tools: RM professionals, Environmental Assessments, WFDSS

3. Operational

Decision-Makers: AA, IC with levels of approval

Goal: Project level RM with time taken to discuss and form comparative options based on given objectives. ORM is typically documented. Results are qualitative, quantitative, and relative.

Tools: JHA, RA matrix, ICS-215a

4. Real-time

Decision-Makers: Individual / Crew vote, project leader, usually, no additional level of approval needed

Goal: Real-time decision-making. Cut tree? Retardant? Hike / Fly?

Tools: Safety rules, protocols, standards, RM guidelines

IV. INTEGRATING THE CONCEPTS OF HIGH RELIABILITY ORGANIZATIONS

The success of High Reliability Organizations (HROs) in managing the unexpected can be attributed to their continuous efforts to act *mindfully* (Weick & Sutcliffe, 2007). HROs organize themselves in such a way that they are better able to (1) ***detect*** the unexpected in the making and halt its development. If they have difficulty halting the development of the unexpected, they focus on (2) ***containing*** it. And if some of the unexpected breaks through the containment, they focus on (3) ***resilience*** and swift restoration of system functioning.

The processes HROs use to manage the unexpected can be broken down like this:

A. Anticipating and Detecting the Unexpected

1. HRO Principle #1: Preoccupation with Failure.

HROs are distinctive because they are preoccupied with failure. They treat any lapse as a symptom that something may be wrong with the system, something that could have severe consequences if several separate small errors happened to coincide…HROs encourage reporting of errors, they elaborate experiences of a near miss for what can be learned, and they are wary of the potential liabilities of success, including complacency, the temptations to reduce margins of safety, and drift into automatic processing.

Example(s):

a. We focus our attention on specific Target Groups associated with ignition problems and regulate their actions based upon fire danger levels. The consequences of making a bad decision could negatively impact the credibility

b. The wildland fire management organization universally recognizes staff rides as outstanding learning tools. Many of these learning opportunities focus on fire fatalities or other significant organizational failures. In this way, staff rides can be an optimum process to help define where “failures”—both big and small—occurred.

Mindfulness Questions:

(1) What do we want to avoid?

(2) What are the consequences of a bad decision?

c. How can we organize ourselves to ensure relevant fire danger information is communicated and positively received by team members and not prevented from reaching the appropriate target group?

(1) How do we interpret weak signals in a timely manner, so they can assist organizational responses?

(2) How do we design fire danger management applications and tools in such a way that fosters an effective institutional environment for weak signal detection?

2. HRO Principle #2: Reluctance to Simplify

HROs restrain their temptation to simplify through diverse checks and balances, adversarial reviews, and the cultivation of multiple perspectives. Less simplification allows you to see more details and variable pictures of what you face. Don't settle for simple interpretations to complex problems. Seek multiple perspectives and opposing viewpoints.

Example(s):

a. The WFDSS (Wildland Fire Decision Support System) analysis is an example of the HRO principle "A Reluctance to Simplify." Through the WFDSS process, details related to a specific incident are exposed. By doing so, alternatives based on costs, benefits, and safety can be evaluated and recommended to a decision-maker.

Mindfulness Questions:

(1) Have we encouraged people ask questions and bring up tough issues?

(2) How many times have we done this the same way?

(3) Do we understand why this will work?

3. HRO Principle #3: Sensitivity to Operations

HROs make strong responses to weak signals (indications that something might be amiss). Everyone values organizing to maintain situational awareness. Listen to the advice/concerns of the people who are actually doing the work. Check for comprehension; acknowledge what you hear. Withholding information because of fear, ignorance, or indifference is unacceptable.

Example(s):

a. Continual status checking throughout the day. "Where you at? How's it going?

Mindfulness Questions:

(1) What are we doing, and why is it important?

(2) Do we understand our leader's intent and expectations?

(3) Who's doing the work, and what do they think about it?

(4) Containing the Unexpected (if it occurs)

4. HRO Principle #4: Commitment to Resilience

HROs pay close attention to their capability to improvise and act—without knowing in advance what will happen. Develop capabilities to detect, contain, and bounce back from inevitable errors that are part of a complex and dynamic environment. Learn to improvise with what you have. Ensure continuous learning.

Example(s):

a. Managing emergencies or accidents as "incidents within incidents" seems an intuitive way to organize and exemplifies a commitment to resiliency. Doing so ensures that the majority of the organization's energy remains focused on its primary objective (such as supporting a wildland fire incident), while making sure that the emergency is adequately addressed as well.

Mindfulness Questions:

(1) Do we use our abilities and knowledge in creative ways to mitigate fire problems?

(2) Do we regularly audit our situation identifying: 1) our main capabilities, 2) our key vulnerabilities, and 3) ways to adapt?

(3) When we experience a set-back, do we encourage each other to quickly identify and fix the mistakes and move forward without reflecting u

(4) Do we regularly work to build people's understanding of fire danger applications?

(5) Do we encourage each other to learn from our experiences (good or bad) and properly frame them for continuous improvement?

(6) Are we ready for the unexpected crises that will inevitably occur?

(7) Can we quickly identify what we must let go of in the face of change and what we should retain?

5. HRO Principle #5: Deference to Expertise

   HROs shift decisions away from formal authority toward expertise and experience. Decision-making migrates to experts at all levels of the hierarchy during high tempo times. Push decision-making down and around. Authority migrates to the people with the most expertise, regardless of their rank or grade. Not necessarily the "most experience," which is too often the same experience repeatedly.

   Example(s):

   a. As our wildland fire operations become more complex and complicated, our Incident Command System (ICS) system is designed to respond to these complexities by deferring to the expertise of a team or incident commander. Depending upon the circumstances, we defer to someone who is more experienced with the situation — regardless of the GS-level.

   b. PocketCards focus their messages on what line personnel need to hear regarding potential fire behavior, describing how a new fire might affect them. We can effectively reinforce the expertise in field-going personnel by asking them questions in the operating environment which validates (or not) the expected fire behavior. Did the fire behave as expected? Did the line personnel have enough information to interpret the Pocket Card?

   Mindfulness Questions:

   (1) What have we done to identify what others need to hear?

   (2) Are we sharing the information down and around for people to hear?

   (3) Are we communicating information in ways that people can easily and promptly determine if it will be important to them?

   (4) Are we prompting expert reactions among personnel who need to be able to discern new patterns quickly?

   (5) Have the "experts" been empowered to voice their thoughts or make decisions?

V. OPTIMIZING OUTCOMES WITH FIRE DANGER

Bad decisions can often be traced back to the way the decisions were made ─ the alternatives were not clearly defined, the right information was not collected, the risks and benefits were not evaluated. But sometimes the fault lies not in the decision-making process but rather in the mind of the decision maker. The way the human brain works can sabotage the choices we make (Hammond, Keeney, & Raiffa, 1999). As mentioned previously, decisions are influenced at multiple levels of our organizations. Therefore, application of risk management concepts necessitates training for both those charged

with developing and implementing fire management strategies and their supervisors responsible for reviewing major strategies and individuals' performance. Unfortunately, there is no formal risk management training offered within existing Interagency fire training programs or for line-officer career development (Calkin, Finney, Ager, Thompson, & Gebert, 2011).

A. Staffing Levels

Form a basis of short-term (daily) decisions regarding the "degree of readiness" at the local unit for initial attack.

1. Staffing Level Questions:

    a. How many people should I have work tomorrow?

    b. Should I extend the fire suppression resources beyond their normal work hours this afternoon? How many people? Which resources? How long?

    c. Will our Staffing Level support the anticipated Response Levels? In other words, will we have enough staff to send to the fire(s)?

2. Staffing Level Decision Traps:

    a. Funding Issues: If we haven't accounted for day-to-day (short-term) needs, the ability to implement Staffing Level decisions is compromised. If we do nothing since funding has always been the obstacle to implementation (assuming there is no resolution), this is a status quo decision trap.

B. Dispatch or Response Levels

Preplanned actions which identify the number and type of resources (engines, crews, aircraft, etc.) initially dispatched to a reported wildland fire based upon fire danger criteria.

1. Response (Dispatch) Level Questions:

    a. At what level is there an automatic dispatch for air tankers?

    b. What response level requires multiple resources (dozers, engines, etc.)?

2. Response (Dispatch) Level Decision Traps:

    a. Many times, units set up Response Levels based on local full-time staff. However, fire managers can order additional resources from adjacent or outside units to support them during periods of high initial attack activity. Assuming that the only suppression resources that can

fill orders in accordance with a local Response Plan is an example of a "framing" decision trap.

C. Preparedness Levels

Are five-tier (1-5) intended to be a long-term (weekly / monthly) decision tool based on NFDRS output(s) and other indicators of fire business (such as projected levels of resource commitment).

1. Preparedness Level Questions:

   a. At what level should MAC groups be activated?

   b. When should additional decision support resources be ordered such as a decision support center, SOPL, etc.?

   c. At what point (when) do I feel comfortable letting resources go off-unit to fire or detail assignments? Draw-down Levels?

   d. When is the Duty Officer required to be on site in the dispatch office?

2. Preparedness Level Decision Traps:

   a) It is not uncommon for units to make determinations of preparedness levels based on limited criteria or lack of understanding of appropriate criteria. This would be an example of a shooting from the hip decision trap.

D. Adjective Fire Danger Rating Levels

Are five standard adjective descriptions intended to be used for public information and signing.

1. Adjective Fire Danger Rating Level Questions:

   a. How often should change Smokey's arm?

   b. When should public service announcements start?

   c. What other decision tools should be tied to this?

   d. Prescribed Burn Approval (USFS)

   e. "Managed Wildfire" Approval?

2. Adjective Fire Danger Rating Level Decision Traps:

   a) A common practice to determine adjective fire danger rating is to standard product out of WIMS. This could easily produce some inconsistencies

with some other decisions such as restrictions. This would be an example of a status quo decision trap or an anchoring trap.

E. Restrictions (Public/Industrial)

Can regulate the public's activities through the implementation of restrictions and closures or the regulation of industrial entities involved in land management activities. NFDRS can be used to determine critical thresholds when these restrictions/closures should be considered.

a. Restrictions Questions:

(1) When should local/state agencies stop issuing burn permits?

(2) When should the Forest close access?

(3) When is firewood cutting allowed?

(4) When are contractors restricted from harvest operations?

2. Public Use Restrictions Decision Traps:

a. Units which do not have any clear criteria for establishing public or industrial restrictions maybe experiencing an overconfidence in judgment decision trap. Individuals functioning under this trap fail to collect key factual information.

VI. SUMMARY

Routinely, we are asked to make tough decisions under a compressed time frame, given limited information, in a complex and high-risk environment. This operational environment routinely brings together people, machinery, and the destructive energy of wildfire in the close, three-dimensional space of the fire-ground and its airspace.

Wildland fire operations have inherent risks that cannot be eliminated, even in the best of circumstances. However, application of existing Fire Danger tools can optimize the outcome of our decisions which ultimately impact the public, industry, and our agency personnel; effectively, managing the associated risk.

HROs develop capabilities to detect, contain, and bounce back from those inevitable errors that are part of an indeterminate world. The signature of an HRO is not that it is error-free, but that errors don't disable it. Resilience is a combination of keeping errors small and of improvising workarounds that keep the system functioning.

An HRO will acknowledge that people will make mistakes . . . An HRO will instill the competencies necessary to contain the mistakes before they become insurmountable or fatal . . . if undetected, an HRO will have the ability to shift

decision-making to the expertise, improvise as needed, learn from mistakes, and find strength from continuous improvement.

REVIEW OBJECTIVE(S)

Upon completion of this lesson, participants will be able to:

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