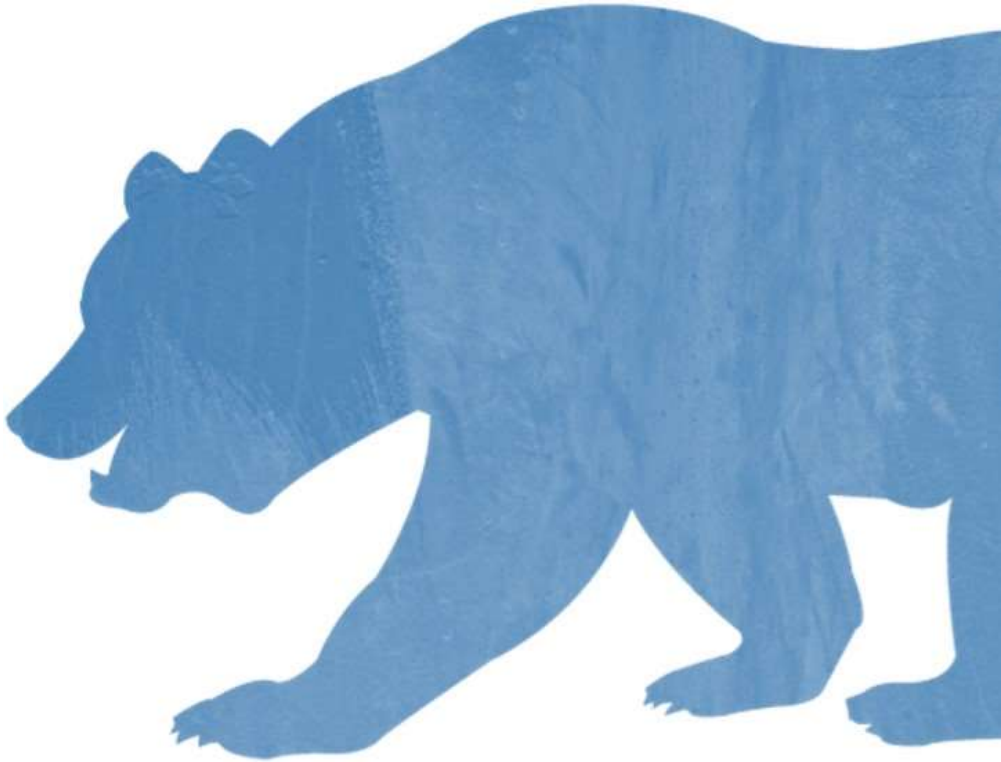
California's Oilfield Technology Delivers Safe, Reliable, Native Production

Ester Brawley – September 2018

CALIFORNIA RESOURCES CORPORATION

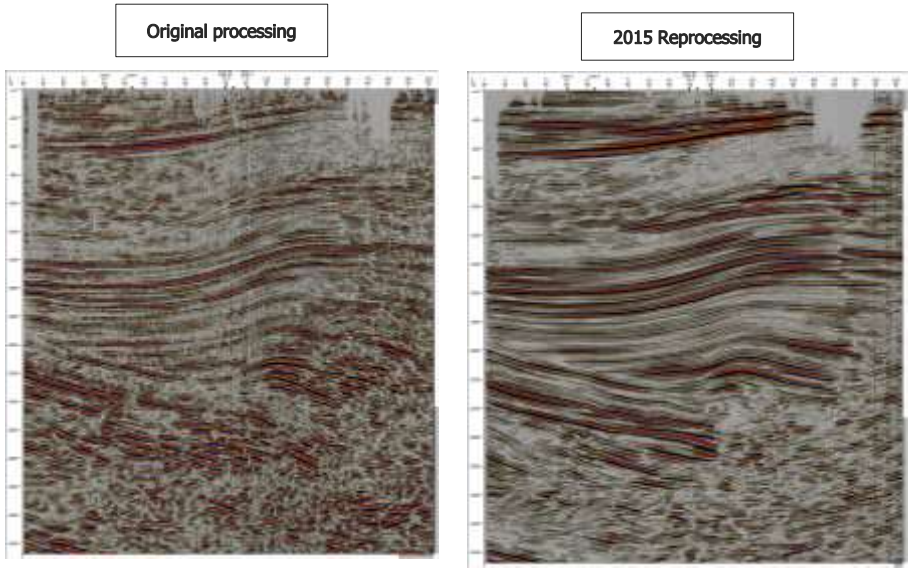
SUBSURFACE INNOVATIONS



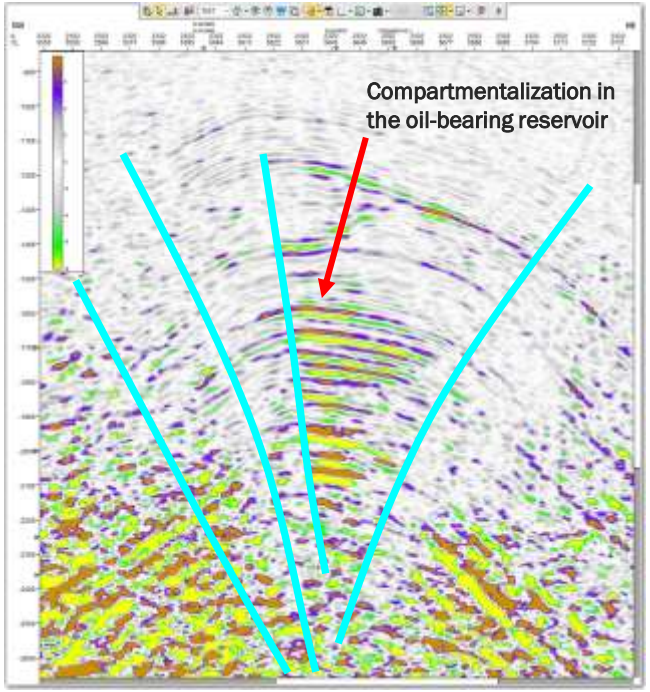
INCREASED FOCUS & PRECISION

- Data Analytics
  - Implemented excel based tool that employs machine learning techniques to quickly screen hundreds of wellbores and selects the best maintenance jobs
- Advanced SCADA Systems Reduce Well Downtime and Subsequent Maintenance
- Reservoir Modeling
  - Streamline monitoring (StreamSim 3DSL Simulator)
    - Helps optimize the waterflood
    - Reduced downtime, reduced facility wear & tear, reduced capital investment
- Geologic modeling
  - Seismic reprocessing
    - Improving image resolution of the 1995 Seismic data
    - Help us identify trapped oil deposits within the oil-bearing reservoir

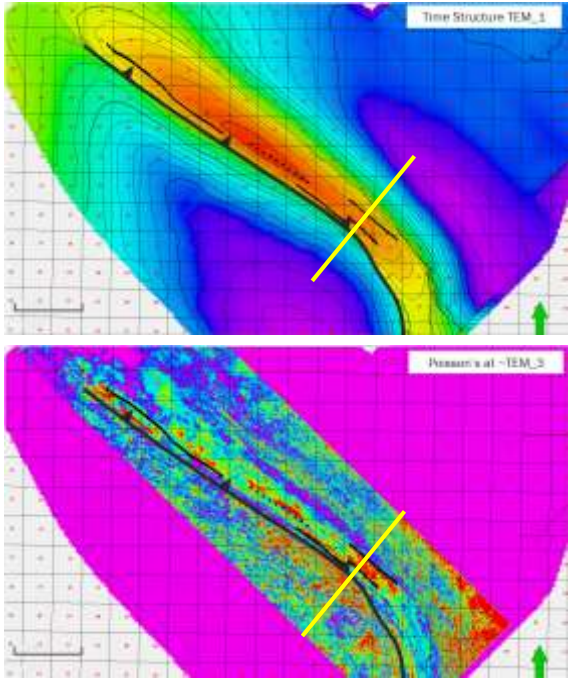
Maintains and Increases Production Within Small Geographical Footprint



This Process Identified Trapped Oil Deposits in a 100 Year Old Field



AVO Volume , Poisson Ratio



Trapped oil deposits are visible and are future drilling candidates

Maintain and Increase Production Within a Small Footprint
Blend Into Surroundings and Community

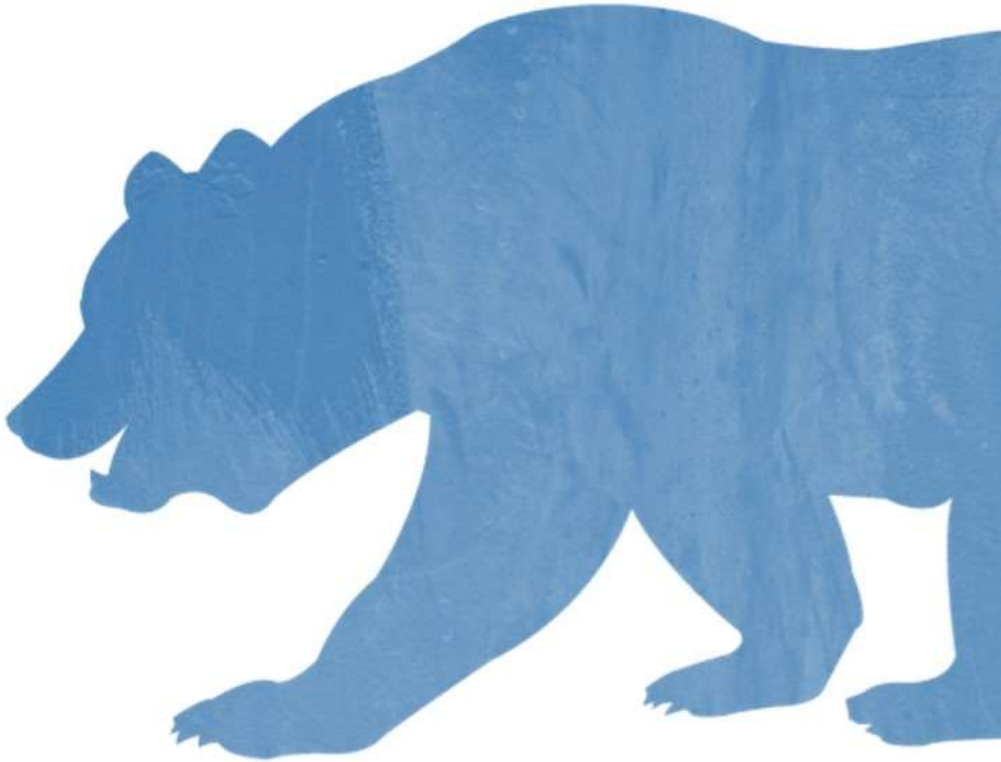
CRC PROPERTIES ALLOW WILDLIFE TO THRIVE

Maintain and Increase Production with Small Geographic Footprint

- CRC leases, owns, and operates areas of land in Ventura County
- The most common way land is used is for creating a well pad – a small area that has been cleared for equipment to install an oil well(s).
- <5% of the land has equipment or has been cleared for a Well Pad.
- So little land is used by CRC that most is left untouched.
- Native plants flourish and wildlife roam freely

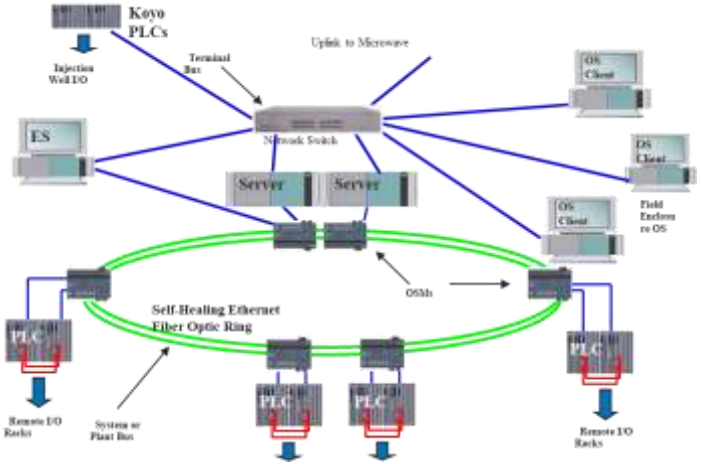
Oil Field Boundary (DOGGR Database) **CRC Well Pad**

SAFETY SYSTEM AUTOMATION UPGRADES



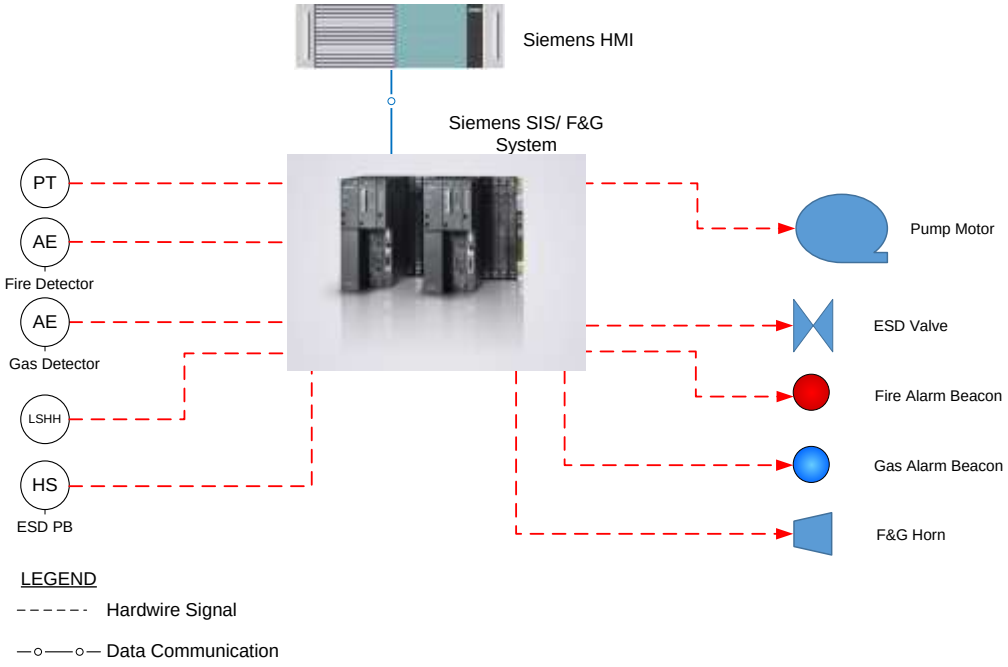
SAFETY SYSTEM AUTOMATION UPGRADES

- Supervisory Control & Data Acquisition (SCADA) system that is combined with powerful application knowledge for our 24/7 Operations Staff.
- Advanced system diagnostics that are easily interpreted by Operations for response
- Exception processing and reporting significantly reduces the effort required to find and address anomalies.
- In addition to improved well and surface facility performance, this technology is utilized to provide emergency shutdown of our wells
- Minimize nuisance trips while achieving high standard of safety shutdowns.
- Two Independent SCADA Systems – Basic Process Control PLC and Emergency PLC



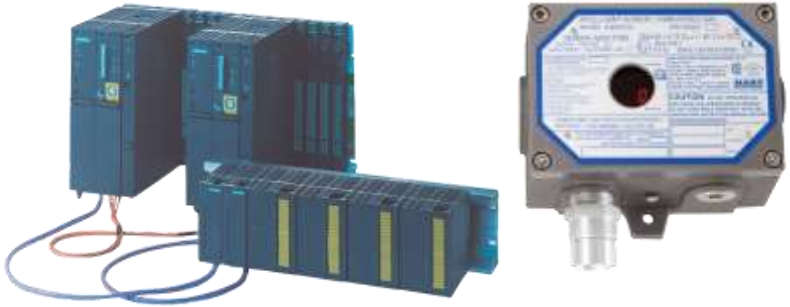
SAFETY SYSTEM AUTOMATION UPGRADES

- System Architecture: Block Diagram

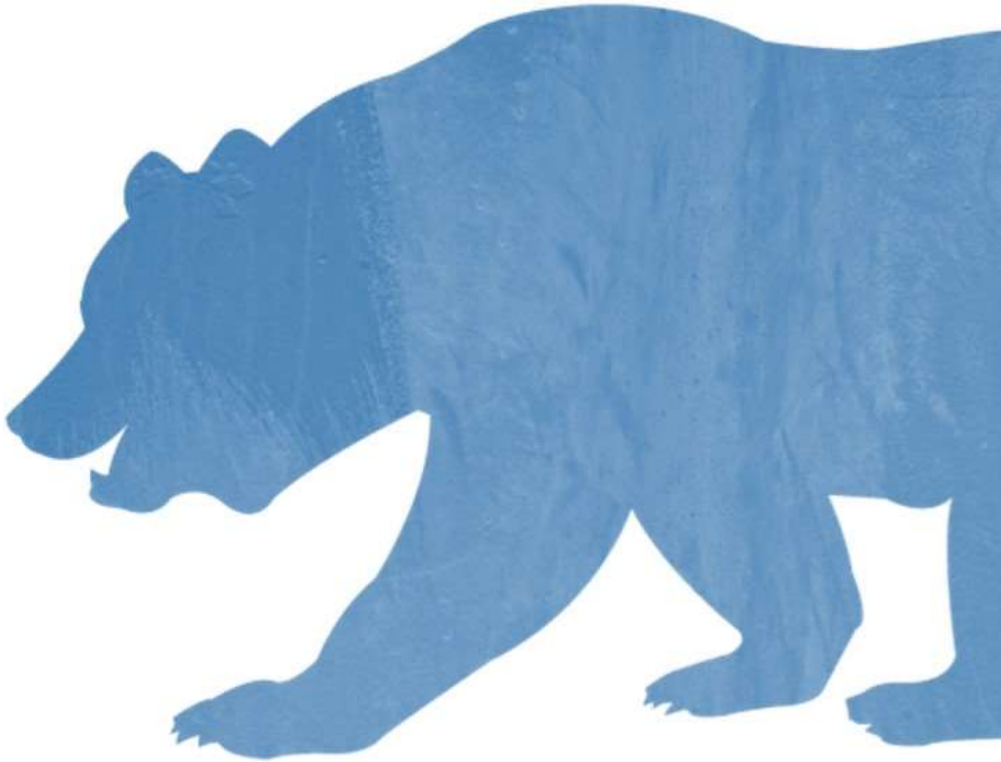


SAFETY SYSTEM AUTOMATION UPGRADES

- Emergency PLC Features
  - Integrated Control & Safety Capable
  - IEC 61508 Certified (International Safety Standard)
  - TUV Rheinland - International Certification Agency
  - Redundant Systems
  - Integrated Redundant Safety Network Technology
  - Diagnostics of Network Integrity is alarmed to Operator
  - Safety functions to detect and handle errors are included in CPU, I/O and Network
  - Fire & Gas detectors have internal fault detection.
  - Event logging stores fault, gas check, calibration, and alarm event history.



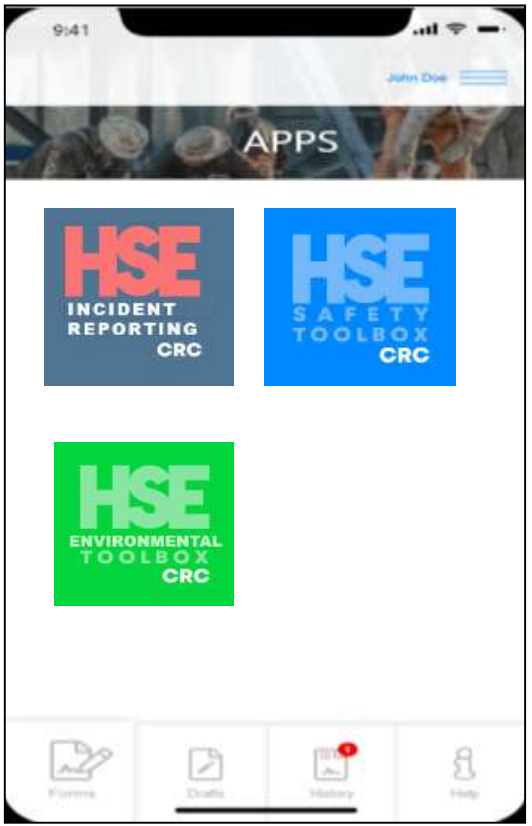
STREAMLINE AND IMPROVE HSE PROCESSES



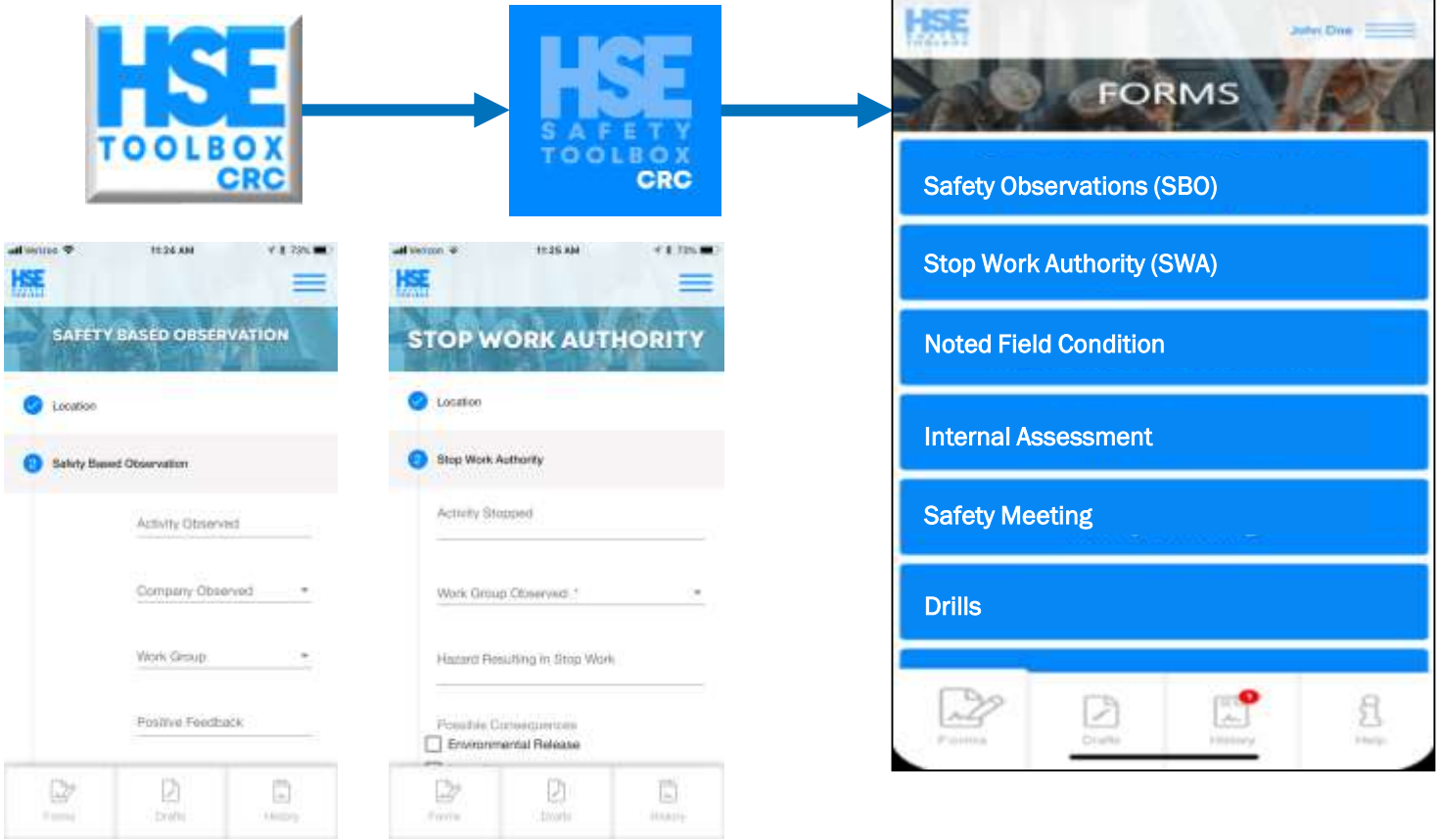
STREAMLINE AND IMPROVE HSE PROCESSES

- CRC is actively and aggressively transitioning all of our HSE processes to Mobile Apps
- Add value to Operations in their role as the owners of our Safety and Risk programs.
- Collection of real time data allows targeted messaging, initiatives and real-time feedback.
- Prevent or mitigate safety and environmental incidents
- Provide checklists for HSE processes, safe work practices, SPCC, and other inspections - such as well handovers.

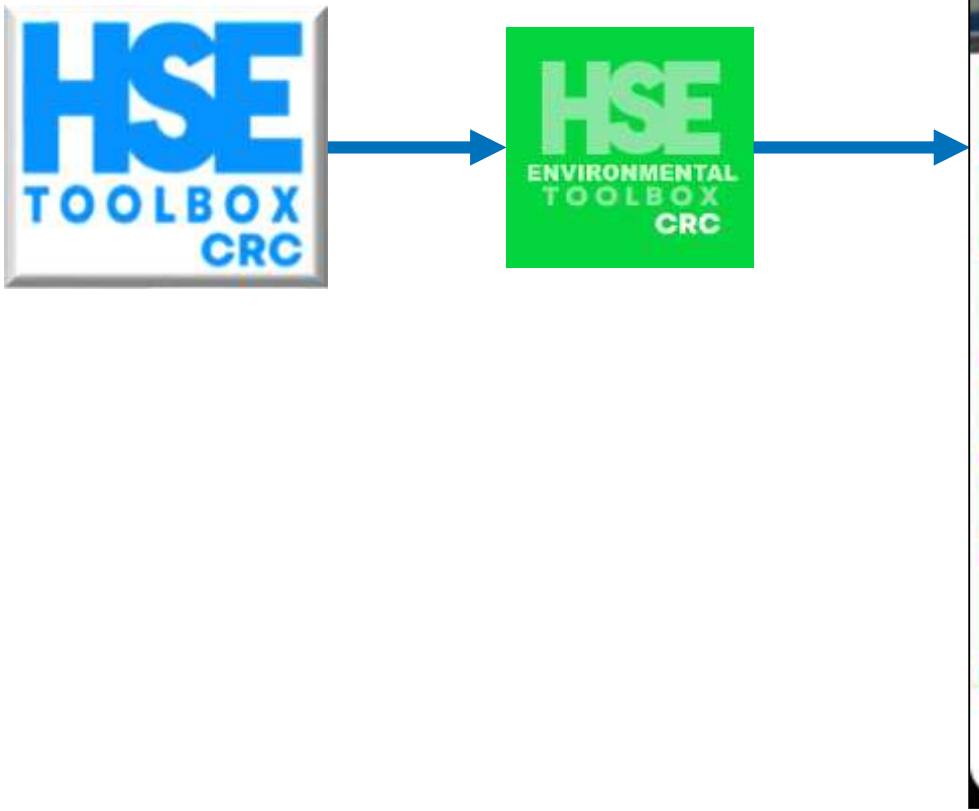
HSE TOOLBOX CRC



Safety Toolbox

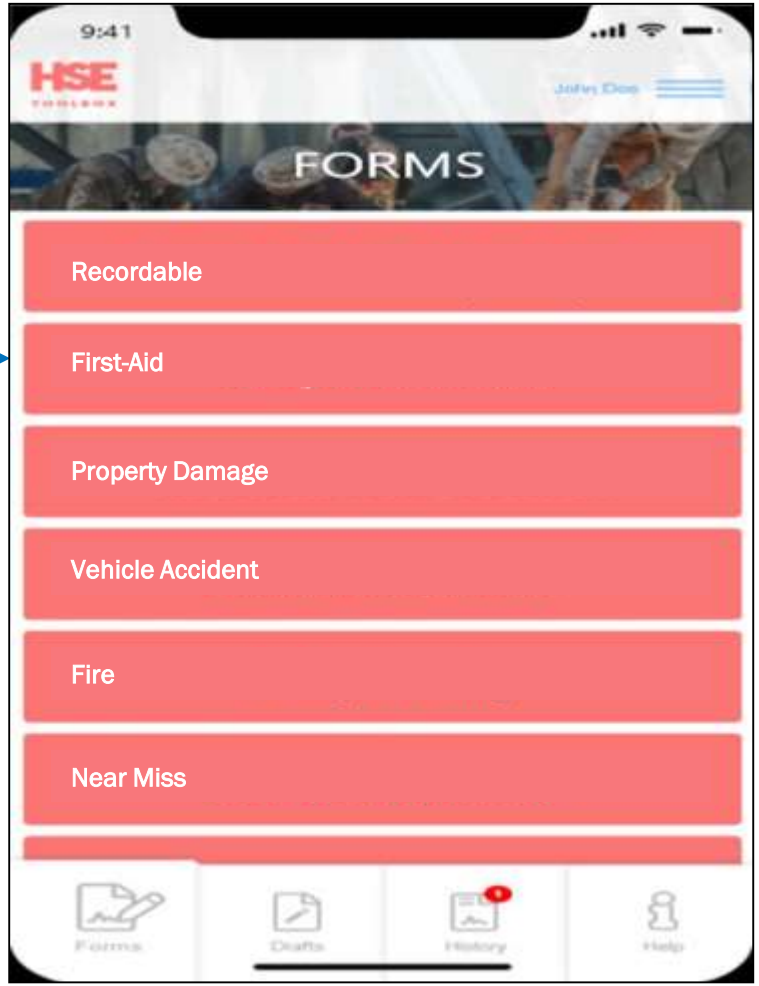


Environmental Toolbox

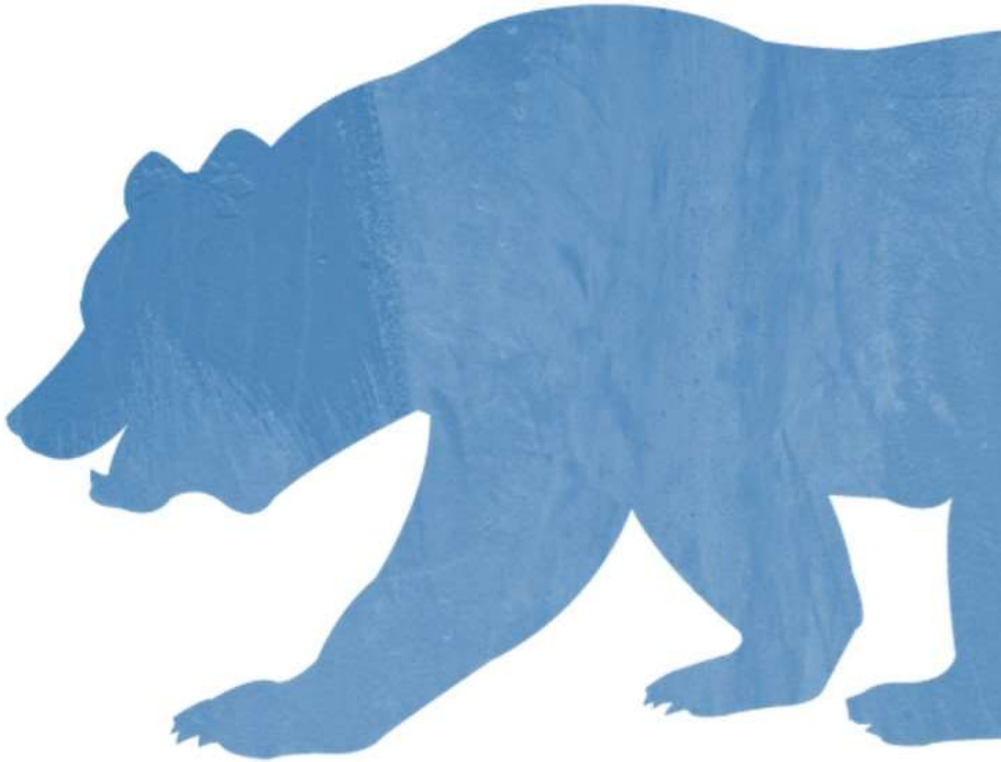


Incident Reporting

HSE TOOLBOX CRC → HSE INCIDENT REPORTING CRC →

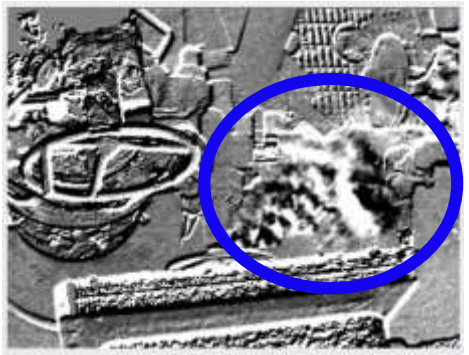


DECREASE EMISSIONS



Optical Gas Imaging (OGI) Technology

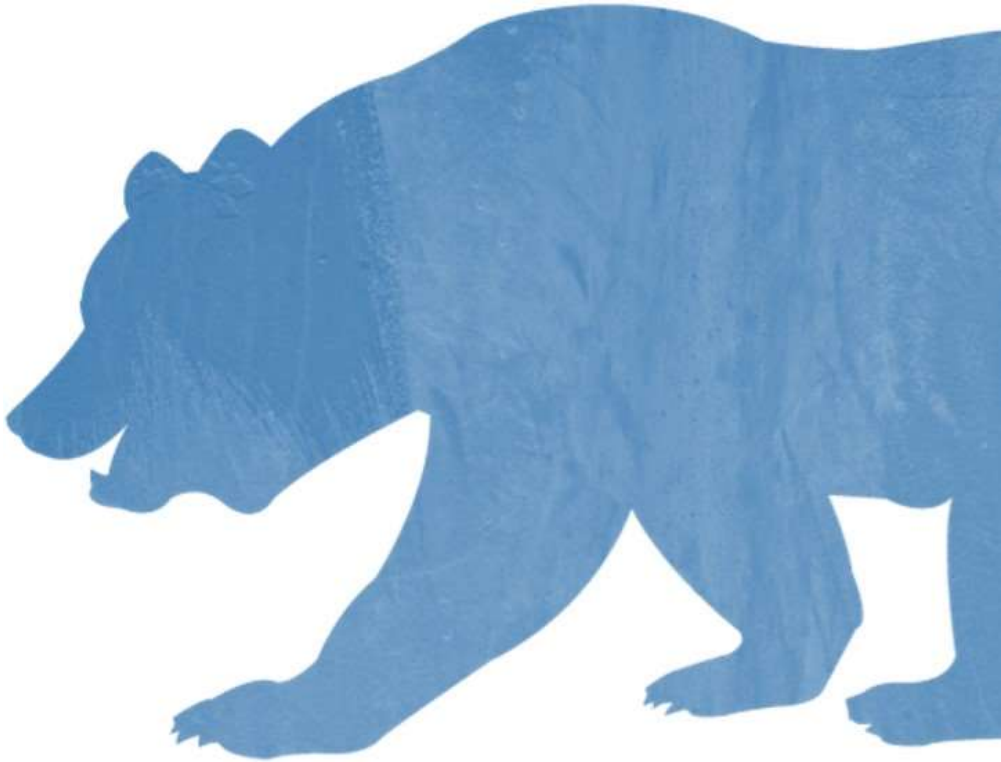
- FLIR® cameras and OGI technology allow CRC to use a handheld camera with a sensor capable of detecting and visually displaying minor gas leaks for intervention by operators.
- A single oil basin has over 100,000 components that must be checked for leaks on a regular basis.
- With this optical gas imaging camera, CRC inspectors can check thousands of components from a distance and find and repair potential gas leaks quickly.
- Helps CRC to maintain a leak-free environment.



Certified Ultra-Low Emissions Burner (CEB) Flare

- CRC makes advances in reducing emissions each year
- One application utilized is a Certified Ultra-Low Emissions Burner (CEB) Flares which reduces emissions by approximately 50% compared to a typical flare.

MECHANICAL INTEGRITY



Mechanical Integrity

- The ability to inspect pipelines is affected by the pipeline route or configuration, materials of construction and surface access.
- Complex inspection challenges in Southern California may include elevation changes, varying depth of cover, internal coatings and changes in diameter.
- Operating environments such as harbors, roadways and construction areas affect access for inspections and may give rise to third-party line strikes.
- CRC's Mechanical Integrity team evaluates new techniques to inspect inaccessible pipelines.
- Examples include:
  - progressive pigging
  - ultrasonic and magnetic flux leakage smart pigs
  - dual diameter in-line inspections

- The MI team's inspection techniques and data analysis help to detect anomalies, prioritize maintenance and set operating conditions to prevent and mitigate incidents.

INNOVATION & TECHNOLOGY ALLOW CRC TO MAINTAIN AND INCREASE SOCIALLY RESPONSIBLE NATIVE CALIFORNIA PRODUCTION