1. What can be done to improve the fire detection in a container cargo under deck?

* Installation of fixed thermal (infrared) imaging system covering at least the gables of all containers stowed below deck. Output connected to intelligent signal processing for automatic detection and alarm.
* Installation of (several) remote IoT CO2 sensors (ref <https://www.manxtechgroup.com/forest-fire-detection-using-iot-and-co2-sensors/>) at strategic locations in the cargo hold. An increase of CO2 content will trigger an alarm and prompt further investigation.
* Installation of remote thermal sensing system, one measuring point for each container (ref <https://www.radicos.com/>), with intelligent signal processing/alarm.
* Installation of video analytics software on (existing) CCTV circuit for long range detection of smoke/mist. (ref <https://www.fike.com/products/fike-video-analytics/>)

2. What can be done to improve the fire detection in a container cargo on deck?

* Considering the outdoor environment we believe thermal (infrared) imaging system connected to intelligent signal processing is the most robust solution.

As a general comment, in a perfect world there is 100% fire detection coverage on each and every box onboard the vessel. Possibly this can be achieved for newbuilding’s at some point in time.  
A quick fix is to attach self-powered and wi-fi enabled remote sensor on selected boxes with dangerous cargo and otherwise suspected content. This is not a bullet proof solution as faulty declared containers will slip through the net but it might improve the situation somewhat. Relatively quick deployment and manageable cost.

3. What can be done to enable a more precise and quick fire localisation?

* With modern detection systems such as IoT, CCTV and/or infrared camera sensor the location will be automatically and precisely located.

4. What can be done to compensate the deficiencies of CO2 with regard to smothering a fire in a container stow under deck?

* For a CO2 system to function properly the space subject to extinguishing need to be enclosed. An inflatable and fire proof curtain/pillow installed in a recess in the hatch coaming will work as a seal to ensure that the CO2 is confined inside the cargo hold. Deployed simultaneously as the CO2 is released.

5. What can be done to improve the confinement of a fire in containers under deck to the particular cargo hold?

* See pt. 4 above.
* Suggest to install piping for a deluge system covering sections of the stacks in the cargo hold thus enabling partial deluge of a few stack only at a time. To keep down installation cost, and maintain the possibility for retrofit, piping can be open-ended on deck with manual connections directly to fire hose(s). Bilge pumping system to be dimensioned accordingly to avoid flooding of CH when the system is in use.

6. What can be done to improve the confinement of a fire in containers on deck to the particular bay or section thereof?

* A fixed long distance deluge system (aka MSC) on bridge/funnel wings enabling deluge of any stack on deck.
* Alternatively, for existing ships and to keep installation cost down, a portable booster pump/deluge unit connected to the normal fire system with capacity to provide sufficient throw length for deluge of any stack on deck. High-rise type fire nozzle(s) with fixed mount capability to be connected to the unit.

7. What can be done to improve active firefighting on deck bearing in mind reduced crew and local conditions?

* See pt. 6.
* Mandatory “HydroPen” or similar technology allowing penetration and deluge of any container anywhere. Mandatory crew training at regular intervals (ref <https://hydropenfire.com/>)

*8. What can be done to protect vital ship structures under deck and on deck from excessive heat?*

*n/a*

*9. What can be done to improve the protection of deck house and life-saving appliances?*

*n/a*

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A quick fix is to attach self-powered and wi-fi enabled remote sensor on selected boxes with dangerous cargo and otherwise suspected content. This is not a bullet proof solution as faulty declared containers will slip through the net but it might improve the situation somewhat. Relatively quick deployment and manageable cost is on the upside.