[0006] A subsea flowline can be monitored in an effort to assess the ongoing integrity of the flowline and thereby facilitate planned preventative measures and avoid unplanned interventions for unforeseen events, such as unplanned interruption of production. One conventional monitoring method includes performing periodic visual inspections of the flowlines using a Remotely Operated Vehicle (ROV) that can travel along the flowline and gather information with a camera. Alternatively, an in-place monitoring system can be installed on the flowline. The system can include multiple transducers that detect thermal or other data from a plurality of locations along the flowline, and the transducers can communicate the date via a fiber optic cable that extends along the flowline to a receiver. In some cases, the transducers can be powered by the thermal differential that exists between the flowline and the surrounding seawater. While the monitoring system could potentially provide more information than a visual inspection, such systems can be complex, expensive, and unreliable, e.g., because the fiber optic cable can break. Further, the installation of the system can be incompatible with some types of flowlines and certain flowline deployment techniques, and can increase the cost of providing, deploying, and maintaining the flowline.

[0007] A continued need exists for an improved system, apparatus, and method for monitoring a subsea flow device, such for monitoring the temperature or other characteristics along a flowline that is disposed on the seafloor and carries hot produced fluid in an environment of cold sea water. The system, apparatus, and method should be compatible with different types of deployment and provide reliable monitoring of the flow device.

## SUMMARY OF THE INVENTION

[0008] In a first aspect, there is provided an apparatus for monitoring a subsea flow device, the apparatus comprising: a thermoelectric device adapted to generate electric power from a thermal potential between the subsea flow device and surrounding seawater; and a sensor powered by the thermoelectric device and adapted to monitor a characteristic of the flow device and provide a radiation output that is indicative of the characteristic.

[0008a] In a second aspect, there is provided a system for monitoring a subsea flow device, the system comprising a plurality of the above apparatuses, the apparatuses being disposed respectively at successive joints along the length of the flowline, and wherein each apparatus located at a respective joint is configured to communicate signals indicative of the characteristic at a plurality of joints to a successive one of the apparatuses located at a joint successive to the respective joint.

[0008b] In a third aspect, there is provided a method for monitoring a subsea flow device, the method comprising: generating electric power from a thermal potential between the subsea flow device and surrounding seawater; using the electric power to operate a sensor and thereby monitoring a characteristic of the flow device; and providing a radiation output that is indicative of the characteristic monitored by the sensor.

[0008c] The embodiments of the present invention generally provide a system, apparatus, and method for monitoring a subsea flow device, such as a subsea flowline that carries produced fluids from a subsea well. The apparatus generally includes a thermoelectric device and a sensor. The thermoelectric device is adapted to generate electric power from a thermal potential between the subsea flow device and surrounding seawater. For example, the subsea flow device can be a subsea flowline that is formed of a plurality of successive pipe segments joined at joints, and the thermoelectric device can be mounted to the flowline at one of the joints. The apparatus can be attached to the flowline during assembly and deployment of the flowline. With the flowline in