CLAIMS:

1. A protective vest comprising:

a front panel to cover substantially a torso region of a user;

a back panel substantially matching the front cover;

two shoulder straps;

two or more side straps to adjustably connect the front and back panels to fit the protective vest on a user;

a cold spreader and a hot spreader attached to the front panel or the back panel or to both the front and back panels such that part of the attachment at each of the front or back panel has a vent or a plurality of vents leading to a space in between the cold and hot spreaders;

a thermoelectric module (TEM) with a cold junction being mounted on the cold spreader whilst a hot junction is mounted on the hot spreader; and

a thermal insulation separating the cold spreader from parts associated with the hot junction, wherein the thermal insulation is sculptured to form plenums through which air in contact with the parts associated with the hot junction is moved by a blower and exhausted through the vent or plurality of vents.

2. The protective vest according to claim 1, further comprising a heat pipe, with a proximal end of the heat pipe being connected to the hot junction and a distal end is connected to a heat sink.

3. The protective vest according to claim 2, wherein the hot junction, heat pipe, heat sink and blower are disposed in the plenums.

4. The protective vest according to claim 2, wherein the heat pipe, heat sink and blower have a thermal heat dissipation power twice the power generated at the hot junction.

5. The protective vest according to claim 2, further comprising a micro-controller, a micro-climate temperature sensor disposed inside the protective vest, a body temperature sensor and an ambient temperature sensor.

6. The protective vest according to claim 5, wherein the TEM is operated by pulse width modulation (PWM) signal from the micro-controller and by an adaptive control algorithm.

7. The protective vest according to claim 6, wherein the adaptive control algorithm is operated to adjust the duty cycle and rate of cooling of the TEM, speed of the blower or sequence of operation.

8. The protective vest according to any one of the preceding claims is used together with a uniform with materials of the uniform incorporating passive cooling mechanisms.

9. A vest system for a security or military personnel comprising:

a protective vest with active cooling mechanisms according to any one of claims 1-7; and

a uniform having passive cooling mechanisms incorporated into materials of the uniform.

10. The vest system according to claim 9, wherein the passive cooling mechanisms comprise thermal conductive threads interspersed with base materials of the uniform or deposits of super-absorbent polymer (SAP), phase change material (PCM) or highly absorbent phase change composites (PCC).

11. The vest system according to claim 10, wherein the SAP, PCM or PCC expands when wetted, causing the thermal conductive threads to have more contact with both skin of the user and with the cold spreader, thereby increasing transfer of cool energy from the cold junction of the TEM to the user in a hot environment, or causing the thermal conductive threads to have more contact with both skin of the user and with the hot spreader for increasing transfer of warm energy from the hot junction of the TEM to the user in a cold environment.

12. A method for transmitting cool energy from a thermoelectric module, with the thermoelectric module having a cold junction being mounted on a cold spreader and a hot junction being mounted on a hot spreader, which cold spreader is attached to a front panel or a back panel or both front and back panels of a protective vest, the method comprising:

separating the cold spreader from parts associated with the hot junction with a thermal insulation, sculpturing the thermal insulation to form plenums through which air in contact with the parts associated with the hot junction is moved by a blower and exhausted through a vent or plurality of vents to an exterior;

disposing the cold spreader onto a uniform of a personnel wearing the protective vest, with the uniform incorporating a network of thermal conductive threads or deposits of SAP, PCM or PCC material; and

wetting the SAP, PCM or PCC materials with sweat from the personnel and allowing the SAP, PCC or PCC materials to expand cyclically, thereby giving rise to cyclic regenerative cooling at the uniform.

13. A method for transmitting warm energy from a thermoelectric module, with the thermoelectric module having a cold junction being mounted on a cold spreader and a hot junction being mounted on a hot spreader, which hot spreader is attached to a front panel or a back panel or both front and back panel of a protective vest, the method comprising:

separating the hot spreader from parts associated with the cold junction with a thermal insulation, sculpturing the thermal insulation to form plenums, so that air in contact with the parts associated with the hot junction is circulated by a blower;

disposing the hot spreader onto a uniform of a personnel wearing the protective vest, with the uniform incorporating a network of thermal conductive threads or deposits of SAP, PCM or PCC material; and

wetting the SAP, PCM or PCC materials with sweat from the personnel and allowing the SAP, PCC and PCC materials to expand cyclically, thereby giving rise to cyclic regenerative heat transfer at the uniform.