

Amended and Restated 2008 Incentive Compensation Plan

(Full title of the Plan)

Leslie J. Browne, Ph.D., President and Chief Executive Officer

721 Route 202/206, Suite 130, Bridgewater, New Jersey 08807

(908) 864-4444

(Name, address, including zip code, and telephone number, including area code, of agent for service)

Copies of all communications, including all communications sent to the agent for service, should be sent to:

Emilio Ragosa, Esq.

Morgan, Lewis & Bockius LLP

502 Carnegie Center

Princeton, New Jersey 08540

(609) 919-6600

Indicate by check mark whether the Registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer or a smaller reporting company. See the definitions of "large accelerated filer," "accelerated filer" and "smaller reporting company" in Rule 12b-2 of the Exchange Act.

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Large accelerated filer

Accelerated filer

Non-accelerated filer (Do not check if a smaller reporting company) Smaller reporting company

CALCULATION OF REGISTRATION FEE

| Title of Securities to be Registered | Amount to be Registered(1)(2) | Proposed Maximum Offering Price Per Share(3) | Proposed Maximum Aggregate Offering Price(3) | Amount of Registration Fee(4) |
|--|-------------------------------|--|--|-------------------------------|
| Common Stock, \$0.01 par value per share | 1,570,000 shares | \$3.05 | \$4,788,500 | \$616.76 |

On January 1, 2014, an additional 70,000 shares of common stock became available for issuance under the Senesco Technologies, Inc. 2008 Incentive Compensation Plan, as amended and restated in accordance with the provisions (1) of the plan. Additionally, on February 11, 2014, an additional 1,500,000 shares of common stock became available for issuance under the Senesco Technologies, Inc. 2008 Incentive Compensation Plan, as amended and restated in accordance with the provisions of the plan.

Pursuant to Rule 416 of the Securities Act of 1933, as amended, this registration statement shall also cover any additional shares of common stock which become issuable under the Senesco Technologies, Inc. 2008 Incentive Compensation Plan, as amended and restated, by reason of any stock split, stock dividend, recapitalization, (2) combination of shares, exchange of shares, spin-off transaction or other change affecting the outstanding Common Stock as a class without the Company's receipt of consideration, or should the value of outstanding shares of Common Stock be substantially reduced as a result of a spin-off transaction or an extraordinary dividend or distribution, or should there occur any merger, consolidation or other reorganization.

Estimated solely for the purposes of calculating the registration fee pursuant to Rules 457(c) and 457(h) of the Securities Act of 1933, as amended, and based upon the average of the reported high and low sales prices per share (3) of the common stock of Senesco Technologies, Inc. on May 2, 2014, as reported by the OTCQB. Pursuant to Rule 457(h)(2) of the Securities Act of 1933, as amended, no separate registration fee is required with respect to the plan interests.

(4) The filing fee, calculated in accordance with Exchange Act Rule 0-11, is equal to \$128.80 per million dollars of the proposed maximum aggregate offering price.

PART I

Information Required in the Section 10(a) Prospectus

As permitted by the rules of the Securities and Exchange Commission, referred to herein as the Commission, under the Securities Act of 1933, as amended, this Registration Statement on Form S-8 (the "Registration Statement") omits the information specified in Part I of Form S-8.

PART II

Information Required in the Registration Statement

This Registration Statement relates to the registration of an additional 1,570,000 shares (the "Shares") of the common stock, par value \$0.01 per share, of Senesco Technologies, Inc. (the "Registrant"). The Shares are securities of the same class and relate to the same employee benefit plan, the 2008 Incentive Compensation Plan (As Amended and Restated February 11, 2014), as those registered pursuant to the Registrant's registration statements on Form S-8, previously filed with the Securities and Exchange Commission on October 28, 2011, January 4, 2012 and March 8, 2013. In accordance with General Instruction E of Form S-8, the contents of the Registrant's registration statements on Form S-8 (File Nos. 333-177586, 333-178881 and 333-187133) filed with the Securities and Exchange Commission on October 28, 2011, January 4, 2012 and March 8, 2013, respectively, are incorporated herein by reference and the information required by Part II is omitted, except as supplemented by the information set forth below.

Item 8. Exhibits

| Exhibit Number | Exhibit |
|-----------------------|----------------|
|-----------------------|----------------|

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|-------|---|
| 5.1* | Opinion and consent of Morgan, Lewis & Bockius LLP, counsel to Registrant. |
| 23.1* | Consent of McGladrey LLP. |
| 23.2* | Consent of Morgan, Lewis & Bockius LLP (included in Exhibit 5.1). |
| 24* | Power of Attorney (included on the signature pages of this Registration Statement). |
| 99.1* | 2008 Incentive Compensation Plan, as amended and restated. |

* Filed herewith

SIGNATURES

Pursuant to the requirements of the Securities Act, the Registrant certifies that it has reasonable grounds to believe that it meets all of the requirements for filing on Form S-8 and has duly caused this Registration Statement to be signed on its behalf by the undersigned, thereunto duly authorized, in the City of Bridgewater, State of New Jersey, on May 5, 2014.

SENESCO TECHNOLOGIES, INC.

By: /s/ Leslie J. Browne
Leslie J. Browne, Ph.D.
President and Chief Executive Officer

POWER OF ATTORNEY

KNOW ALL MEN BY THESE PRESENTS, that each person whose signature appears below constitutes and appoints Leslie J. Browne, Ph.D and Joel Brooks, jointly and severally, his true and lawful attorneys-in-fact and agents, each with full power of substitution and resubstitution, for him and in his name, place and stead, in any and all capacities, to sign any and all amendments to this Registration Statement, and to file the same, with exhibits thereto, and other documents in connection therewith, with the Securities and Exchange Commission, granting unto said attorneys-in-fact and agents, and each of them, full power and authority to do and perform each and every act and thing requisite or necessary to be done in and about the premises, as fully to all intents and purposes as he might or could do in person, hereby ratifying and confirming all that each of said attorneys-in-fact and agents, or his substitute or substitutes, may lawfully do or cause to be done by virtue hereof.

Pursuant to the requirements of the Securities Act of 1933, this Registration Statement has been signed below by the following persons in the capacities and on the dates indicated.

| Signature | Title | Date |
|---|--|-------------|
| /s/ Leslie J. Browne Leslie J. Browne, Ph.D. | President, Chief Executive Officer and Director (Principal Executive Officer) | May 5, 2014 |
| /s/ Joel Brooks Joel Brooks | Chief Financial Officer, Secretary and Treasurer (Principal Financial and Accounting Officer) | May 5, 2014 |
| /s/ Harlan W. Waksal Harlan W. Waksal, M.D. | Chairman of the Board and Director | May 5, 2014 |
| /s/ John E. Thompson John E. Thompson, Ph.D. | Executive Vice President, Chief Scientific Officer and Director | May 5, 2014 |
| /s/ John N. Braca John N. Braca | Director | May 5, 2014 |
| /s/ Christopher Forbes Christopher Forbes | Director | May 5, 2014 |
| /s/ Jack Van Hulst Jack Van Hulst | Director | May 5, 2014 |
| /s/ Warren J. Isabelle | Director | May 5, 2014 |

Warren J. Isabelle

/s/ Thomas C. Quick
Thomas C. Quick

Director

May 5, 2014

/s/ David Rector
David Rector

Director

May 5, 2014

/s/ Rudolf Stalder
Rudolf Stalder

Director

May 5, 2014

EXHIBIT INDEX

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