Rotary-to-Linear Magnetic Gear

Thang V. Lang, Suleiman M. Sharkh, *Senior Member, IEEE*, Jaime R. Anglada, *Senior Member, IEEE*, Mehdi Hendijanizadeh, and Mohamed Moshrefi-Torbati

[[1]](#footnote-2)

***Abstract*—The paper introduces a permanent magnet rotary-to-linear magnetic gear whose topology is derived based on the operating principle of a transverse flux VRPM machine. It is shown that when the number of poles per unit length on all three members, rotor, translator and stationary flux modulating ferromagnetic pieces, are the same, the proposed gear is essentially similar to a magnetic screw gear with discretised helical magnets. Using different number of poles and iron pieces per unit length provides alternative means for adjusting the gear ratio. The paper describes the design and construction of a demonstrator gear whose dimensions were optimised using finite element analysis. Performance results obtained from finite element analysis and experiment are presented and discussed.**

***Index Terms*—Magnetic gear, rotary-to-linear gear, permanent magnet machines, transverse flux machines.**

# I. INTRODUCTION

M

AGNETIC gears have been the subject of significant research and development in the last 3 decades [1] [2] [3] [4]. Their contactless nature offers many potential advantages: low friction, noise and vibrations; reduced lubrication and maintenance requirements; and the possibility of physically isolating the input and output shafts. They also have an inherent overload capability. However, these advantages come at a significantly increased initial cost, which may be justifiable in some applications. Promising applications include direct-drive turbines [5], ship propulsion [6], electric vehicles [7], and wave [8] [9] and tidal energy [10] harvesting devices, amongst others.

Early magnetic gears were mostly designed to mimic available topologies of mechanical counterparts. Their development can be traced back to 1901, when Armstrong [11] introduced a “power transmitting device” that duplicates the structure of a spur gear, replacing the teeth with electromagnets on one rotating member and ferromagnetic poles on the other. Since then, variants of spur types [12] [13] [14] [15] [16] [17] [18] [19], worm gears [20] [21], and planetary gears [22] [23] [24] have been developed. But all of these have much lower torque densities than their mechanical counterparts.

Most of the research and development effort has so far focused on rotary-to-rotary transmission magnetic gears. In 2001, Atallah and Howe [25] presented a coaxial magnetic gear that is similar in its basic configuration to those patented by Nuland in 1916 [26] and Martin in 1968 [27]. It is based on using ferromagnetic pieces to modulate the flux between the inner and outer members, which carry different numbers of permanent magnet (PM) poles. Since then, many other variants of the basic flux modulation concept, including linear-to-linear gear [28] and transverse flux configurations [29] have been introduced and reported in the literature [1]. Recently, variable reluctance variants have been introduced, where the inner rotor surface permanent magnet structure is replaced with a variable reluctance one, which was claimed to offer advantages of lower losses and torque ripple, and high-speed operation without the need for a retaining sleeve [30] [31] [32]. However, careful parametric sweep optimization by Hasanpour et al. shows that the reluctance magnetic gears tend to have lower efficiencies and more torque ripple in addition to having a lower torque density than PM variants [33].

In contrast, research and development of rotary-to-linear magnetic gears received less attention. The focus has been largely on screw magnetic gears that were introduced by Keller and Sibley in 1912 [34], Andrews in 1925 [35] and others. These mimic a lead screw mechanism with the screw thread replaced by helical magnets or variable reluctance structures interacting with magnets or variable reluctance structure on the ‘nut’ translator. In 1978, Paul [36], [37] described a magnetic device derived based on the principle of operation of a rectilinear reluctance motor [38]; it relies on the interaction between two mild steel helical threads on the inner and outer shafts; permanent magnets underneath the inner rotor helical thread provide the magnetic field excitation; a prototype was built to demonstrate the concept and establish its performance.

Emerging applications such as energy harvesting [9] [39], have provided stimulus for recent research and development of rotary to linear magnetic gears [40], including more recent patents, e.g., [41] [42]. In 2011, Wang et al. [43] presented an analysis of a permanent magnet two start screw rotary-to-linear magnetic gear featuring helically disposed magnets on both the rotor and the translator, similar to that patented by Vitale in 2001 [42]. Subsequently, Pakdelian et al. [44], [45] investigated multiple start screw variants of the magnetic screw, and introduced the name TROMAG; they built a demonstrator with a two start magnetic screw and reported in [45] that “strips of magnets, made of a mixture of Nd-Fe-B and some elastic material(s) are employed” and that “the remnant flux density of the employed magnets is roughly 0.45 T”, which is significantly weaker than sintered magnets, but their flexibility made it easier to construct a PM helix. Recently, the Pakdelian group presented a quasi-Halbach magnet TROMAG [46] and a reluctance variant in which one of the member is furnished with a variable reluctance structure and the other member has helical PM poles confined to the active force producing section of the magnetic gear [30], which economises on magnet material and minimises “leakage flux” produced by magnets outside the active section [47].

Kouhshahi and Bird et al. [48], [49] presented an alternative linear to rotary magnetic gear that combines the principle of a magnetic screw with a helical magnet on the rotor with that of rotary and linear magnetic gears [25] [28] incorporating a layer of flux modulating ferromagnetic rings between the rotor and an outer stationary flux concentrating cylindrical structure comprising ferromagnetic rings sandwiched between rings of axially magnetised permanent magnets. The flux-modulating stationary ferromagnetic pieces are skewed. In addition to adding more degrees of freedom for adjusting the gear ratio, namely the number of ferromagnetic pieces and number of poles on the rotor and stationary outer member beside the PM helix pitch and number of starts in a conventional screw, this magnetic gear, like the reluctance TROMAG described in [30], has the advantage of confining the use of PM material and flux within the active force producing section. Kouhshahi and Bird et al. also introduced a version of the gear without translator skewing [50]; the outer stationary member is skewed instead.

In this paper, we extend our previously published ICEM2020 conference paper [51] where we introduced a rotary-to-linear magnetic gear that was inspired by a 2-phase variable-reluctance permanent magnet (VRPM) transverse flux machine that was reported in [52] and [53]. The paper makes several original contributions. It describes in detail how the rotary-to-linear magnetic gear is derived from the transverse flux machine and then it illustrates that it is essentially similar to a magnetic screw or a TORMAG with a discretised, piece-wise permanent magnet helix on the translator, an analogy that provides further insights into its operation. After introducing several possible variants, the paper proceeds to describing an experimental demonstrator and presents the results of three-dimensional (3D) finite element analysis (FEA) parametric studies that were used to select near optimum dimensions of the magnets and cores of the demonstrator. The torque and force FEA calculations are validated using experimental measurements.

Section II shows how the magnetic gear topology is derived from the transverse flux VRPM machine and establishes the links with PM magnet screw or TROMAG topologies reported by Wang et al. [43], Pakdelian et al. [44], [45] and Kouhshahi and Bird [48], [49] and others. Section III presents the results of a 3D finite element analysis (FEA) parametric study that were used to determine the near optimum dimensions of demonstrator. The design and construction of a demonstrator is described in section 4, which also presents experimental results to validate the FEA calculations. Discussion and conclusions are in sections V and VI, respectively.

# II. Principle of Operation

Fig. 1 illustrates the construction of an inner rotor version of the VRPM transverse flux machine reported in [52] and [53]. For clarity, the outer housing is removed and only a few of the c-cores are shown. Four rows of heteropolar magnet arrays are mounted on the surface of the inner rotor. An array of laminated c-cores encloses each phase coil; the number of c-cores per phase equals the number of rotor PM pole pairs. In this version of the machine, the magnets of the two phases are aligned, but their respective c-cores are shifted by 90 electrical degrees: when the c-cores of one phase (phase 1 in Fig. 1) are aligned with the d-axis, the c-cores of the other phase (phase 2 in Fig. 1) are aligned with the q-axis of the magnet poles. When vector control is used, below base speed with the current in phase 1 will be zero, while the current in phase 2 will be maximum when the rotor is in the position shown in Fig. 1, to maximise the torque per amp.

Diagram

Description automatically generated

**Fig. 1.** An illustration of a two-phase inner rotor VRPM machine showing a partial number of c-cores for clarity. The stator housing that holds the c-cores is also not shown.

Fig. 2 shows a 2-pole version of the machine; this figure reveals the poor utilisation of magnet material in this case, which improves by increasing the number of poles, the key to maximising the torque density of this class of machine (up to a point beyond which flux leakage negates the gains). Nevertheless, the 2-pole machine provides a better starting point for the development of the magnetic gear proposed in this paper.

The alternating current in the coils generates an alternating magnetic field in the airgaps opposite the c-cores, which has maximum strength when the c-cores are aligned with the q-axis of the rotor magnets to produce maximum torque as explained earlier. Now imagine that the c-cores are cut to become I-cores as illustrated in Fig. 3, the coils are removed and arrays of heteropolar magnets are made to pass over the outer ends of the I-core. As the magnets pass by, alternating flux will travel through the corresponding airgaps. If the linear array of magnets corresponding the I-core of the two phases are shifted spatially by 90 electrical degrees such that the d-axis of one array is aligned with the q-axis of the other, then the flux pattern will be essentially the same as that produced by the two-phase coils. Thus, we have a rotary-to-linear magnetic gear. However, clearly the utilisation of materials in this machine is rather poor.

But we can take advantage of the fact that unlike the coils, which generate homopolar flux in all their c-cores, the magnets generate flux in each set of I-cores independently. This means that we can add another set of I-cores per phase on the opposite side with their flux provided by an array of magnets that are shifted by 180 electrical degrees. Furthermore, we can move the I-cores of both phases to be in the same plane to interact with the same rotor magnets. Additionally, we can duplicate the structure in the axial direction to enable the production of greater force and torque as shown in Fig. 4.

Logo

Description automatically generated

c-core

magnet

coil

**Fig. 2.** A 2-pole variant of the VRPM machine.

When bar magnets are used on the translator as shown in Fig. 4, the I-cores provide a low reluctance interface between the rectangular geometry of the translator and the cylindrical rotor. And if the number of poles on the translator (within the active part) is different from the number of poles on the rotor (along the axial direction), the I-cores will be needed to modulate the flux and create flux harmonics on either sides that match the corresponding pole number. This in effect creates a gear that is like that proposed by Kouhshahi and Bird et al. [48], [49], but with the ferromagnetic rings replaced with I-cores.

A picture containing LEGO, toy

Description automatically generated

**Fig. 3.** A rotary-to-linear magnetic gear derived from the 2-pole VRPM machine.

A picture containing LEGO, toy

Description automatically generated

I-core

**Fig. 4.** The final topology of the rotary-to-linear magnetic gear derived from the 2-pole VRPM machine using bar magnets on the translator.

One can also envisage a cylindrical version of the machine as shown in Fig. 5a. When considering the operation of the gears in Fig. 5a as the starting point, it becomes evident that the I-cores are not actually essential to the function of this configuration in which the translator and rotor have the same number of axial poles and I-cores are not needed to modulate the flux to produce different harmonics with different matching pole numbers on either side. They may therefore be advantageously removed as illustrated in Fig. 5b to eliminate the associate core losses and replace the two gaps with one, which increases flux, force and torque at possible additional cost of arc magnets compared to bar ones.

It is interesting to consider an unrolled version of the gear in Fig. 5b without the I-cores. Fig. 6, shows only two rows of magnets on the rotor. One can clearly see that the magnets on the translator form a discretised helix. In other words, what we have here is a machine that is similar to that described by Pakdelian [44], [45] and others, with the helix constructed using discrete magnets. Thus, the link between the two topologies is established.

Furthermore, we can also envisage having a rotor with multi-peripheral poles as shown in Fig. 7. In this case, the translator magnet arrays will form a polygon whose number of sides equals the number of peripheral rotor poles. The greater the number of peripheral poles, the closer the approximation to a helical disposition of the I-cores and magnets.

With reference to Fig. 8, which defines the main dimensions of the magnetic gear, the ratio of angular speed of the rotor to the linear speed of the translator is given by

|  |  |  |
| --- | --- | --- |
|  |  | (1) |

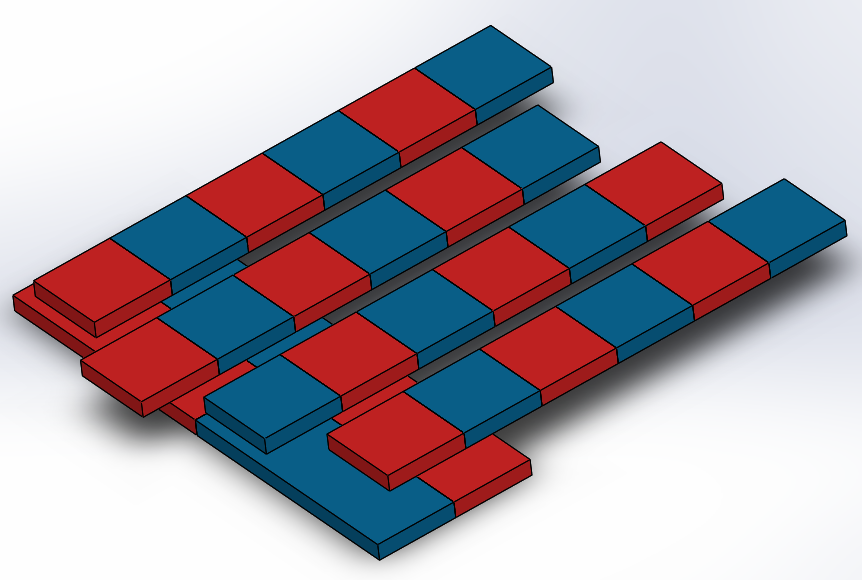
whereis the number of rotor peripheral pole pairs and is the translator’s pole pitch. Neglecting losses, under ideal conditions, the input and output power will be equal, which gives the following relationship between translator force and rotor torque :

|  |  |  |
| --- | --- | --- |
|  |  | (2) |

A picture containing toy, vector graphics

Description automatically generated

**Fig. 5.** Final topology of a rotary-to-linear magnetic gear with arc magnets derived from the 2-pole VRPM machine, a) with I-cores, b) without I-cores.



Rotor magnets

Translator magnets

**Fig. 6.** Unrolled cylindrical magnetic gear without ferromagnetic I-cores.

A picture containing LEGO, toy

Description automatically generated  
**Fig. 7.** A rotary-to-linear magnetic gear with 6 peripheral rotor poles.

# III. Finite Element Analysis

Analytical methods and 2D FEA models similar to those described in [43] and [44] were used to make some initial estimates of torque and force of candidate configurations and geometries and to gain some insights into design trade-offs. But while these methods are quick, they tend to significantly overestimate torque and force due to neglecting end effects and not taking into consideration the 3D nature of the device. Three-dimensional FEA was therefore used to aid the selection of magnets with near optimal dimensions, determine the optimal dimensions of the iron core, as well as determining the thickness of the back of core of a demonstrator using off-the-shelf magnets. Fig. 8 shows the principal dimensions of the demonstrator. Considering the magnet demagnetisation results reported in [45], the thicknesses of the rotor and translator magnets were selected to be the same. Based on available off-the shelf magnets and overall size considerations, the rotor diameter and the active length of the translator were selected to be 30 mm and 40 mm, respectively. The number of translator poles in the axial direction was selected to be 4 (. The translator’s back iron thickness and thickness of the rotor yoke were made large enough to carry the flux without undue saturation.

A picture containing LEGO, toy

Description automatically generated

**Fig. 8.** Principal dimensions of the demonstrator.

Ansys Maxwell 3D FEA was used to conduct a parametric study, varying magnet and I-core dimensions. The 2D FEA studies mentioned earlier and subsequent iterative 3D FEA studies showed the key magnet and I-core parameters shown in Fig. 8 were largely independent in the range of practical values determined by manufacturing considerations and dimensions of available magnets. It is therefore sufficient to consider the effect of each parameter independently, but we fixed the other parameters to sensible values, e.g. the gap, was fixed at 1 mm as determined by manufacturing tolerances, the width of the magnet, was chosen to match those available in the catalogue and the heigh of the I-cores, was chosen to be the practical minimum.

Fig. 9 shows an example of radial and axial flux distributions at a particular position (model geometry is shown in Fig. 8).

Fig. 10 shows the torque and force variation as a function of rotor angle for the near optimal design variant. The rotor zero angle is selected to be the point when the force is zero; the position depicted in Fig. 9. The force varies sinusoidally as expected, but the torque curve exhibits some distortion due to reluctance torque resulting from the interaction of rotor magnets with the partially saturated I-cores.

Figs. 11-16 show the dependence of pull-out torque and force on magnet thickness, magnet coverage (the ratio of , air gap and I-core dimensions. As expected, torque and force increase as magnet thickness and coverage increase but with diminishing returns. Increasing the airgap reduces torque and force, so does the thickness of the I-core, due to increased reluctance. However, the length of the I-cores and their thickness have an optimum value at which the torque and force are maximum. Initially, the torque and force increase as and increase as expected, but then flux leakage between magnets on the rotor and translator starts to dominate; ultimately the I-cores short circuit the flux when they touch each other at which point the torque drops to nearly zero.

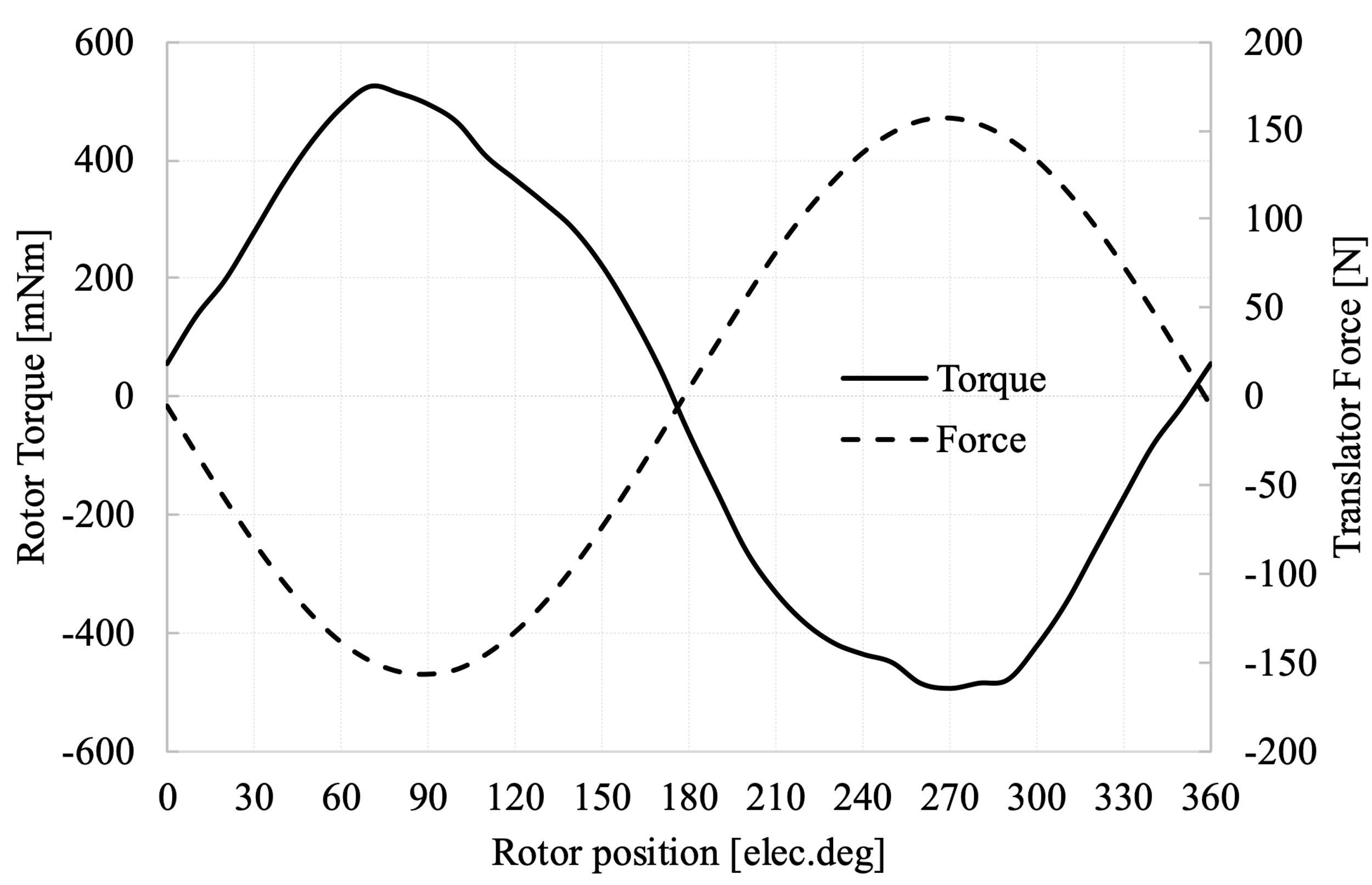
Based on the graphs in Figs. 11-16 and available off-the-shelf magnets, the near optimal dimensions were selected as shown in Table 1. A magnet thickness of 5 mm was chosen, at the point beyond which force and torque gains start to diminish as can be seen in Fig. 11. A magnet coverage of 100% was chosen to simplify the construction even though a coverage of about 90% gives slightly greater torque and force (Fig. 12). An airgap of 1 mm was chosen to provide a clearance that is compatible with achievable tolerances. The dimensions of the I-core were selected as close as possible to torque and force maxima in Fig. 14-16, while considering available materials and manufacturing constraints.

Graphical user interface

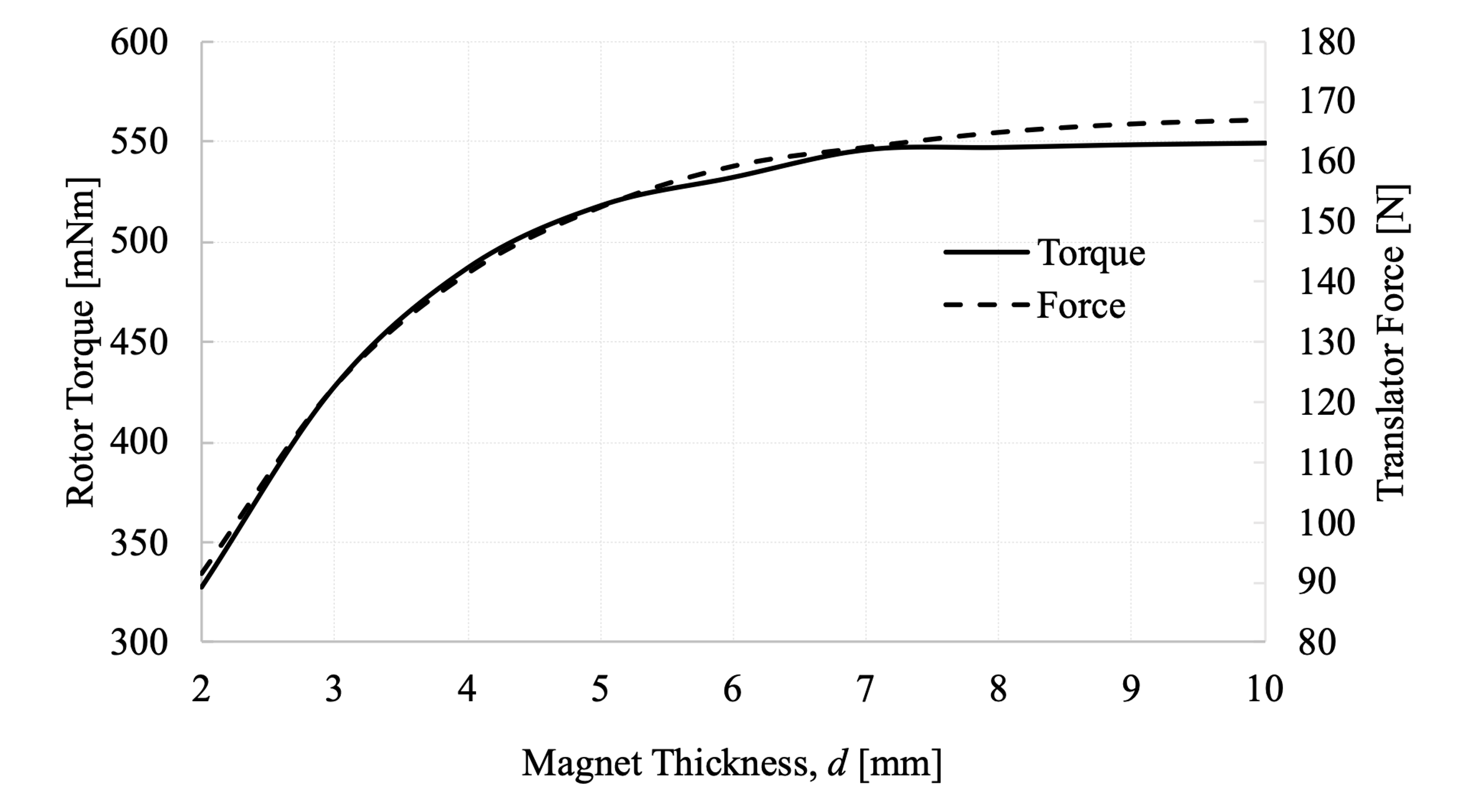
Description automatically generatedGraphical user interface, chart

Description automatically generated

**Fig. 9.** Flux distribution when the rotor position is 90 degrees.



**Fig. 10.** Torque and force versus rotor position obtained from 3D FEA ().

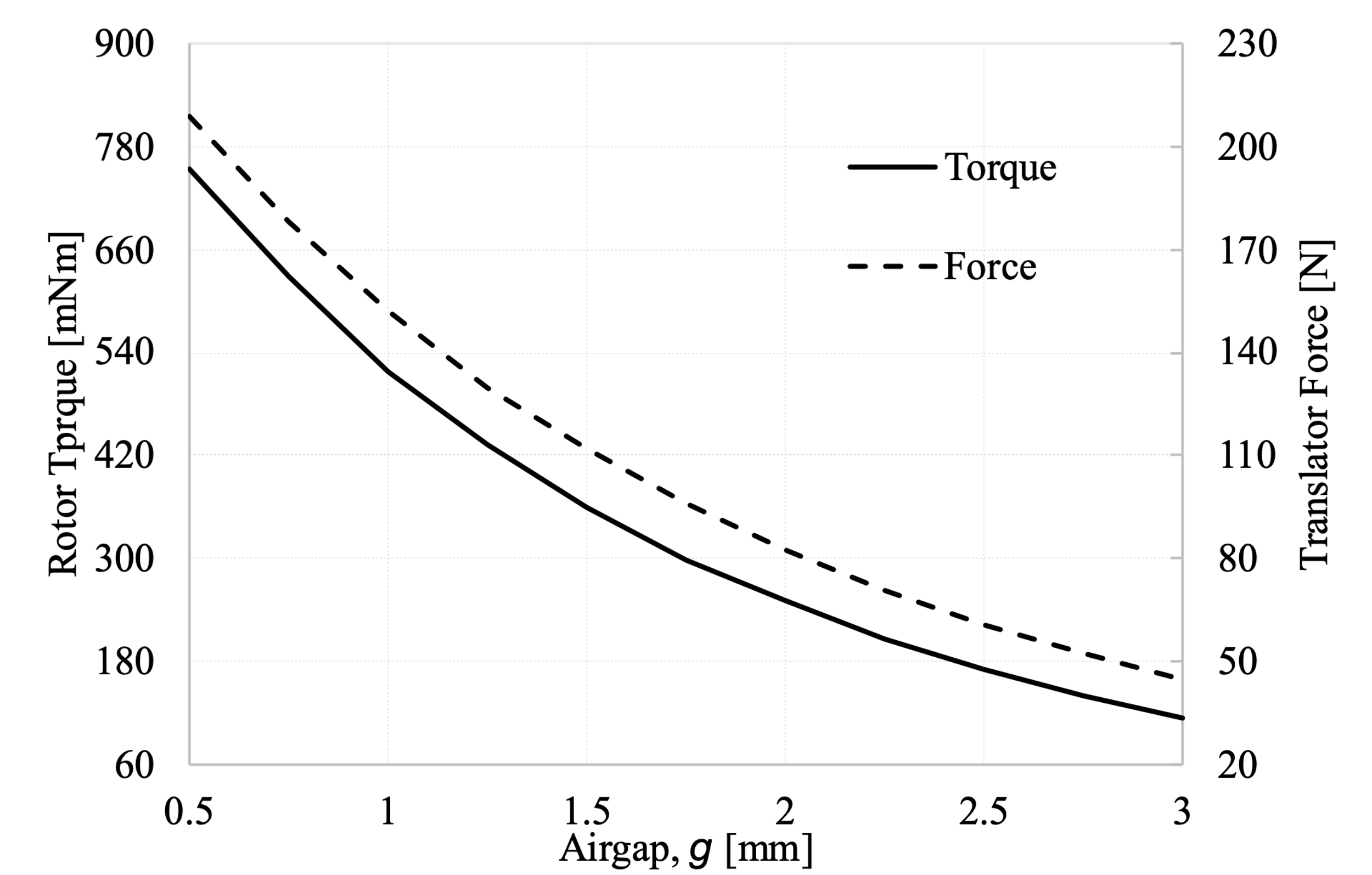


**Fig. 11.** Pull-out torque and force versus magnet thickness ().

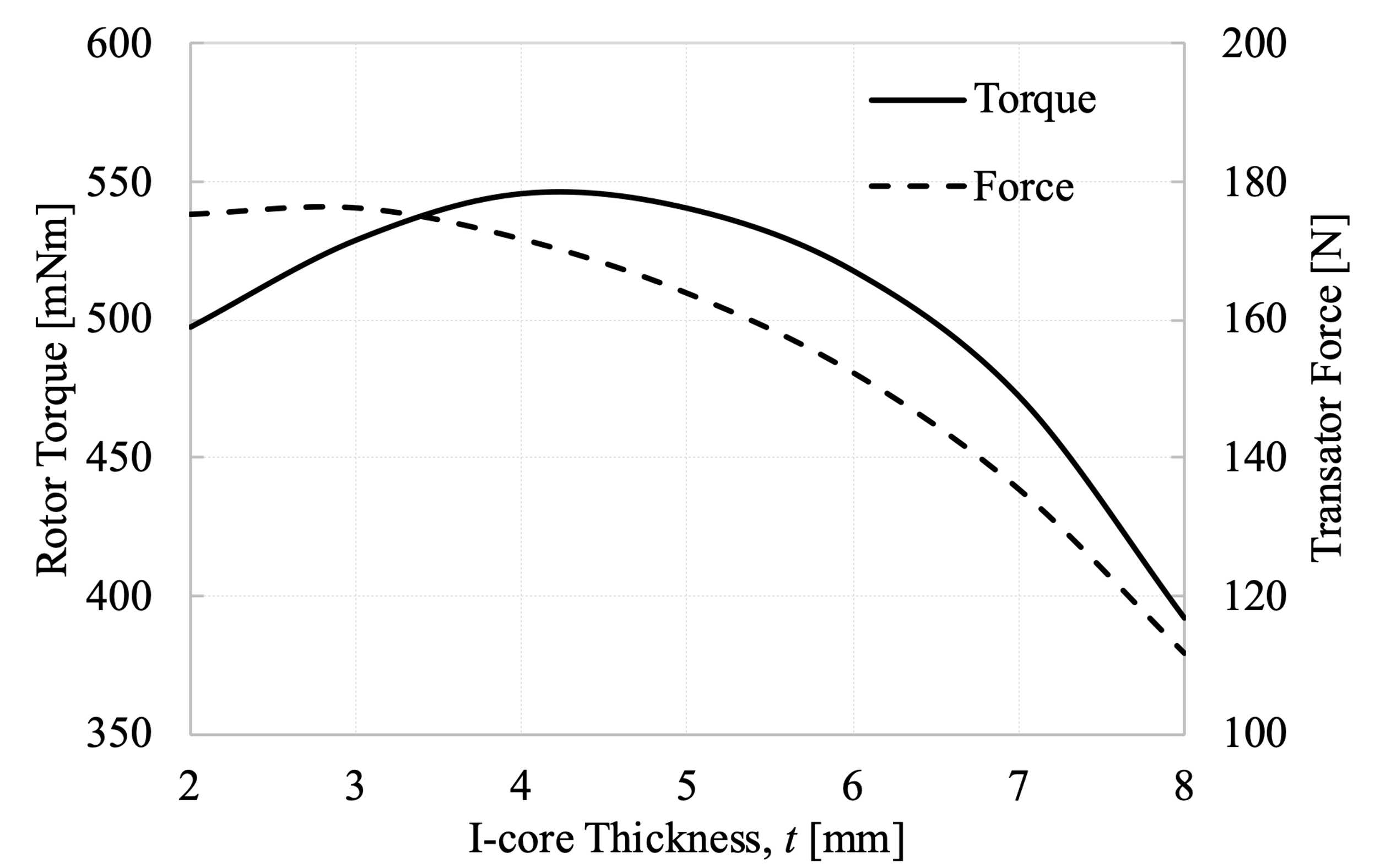


**Fig. 12.** Pull-out torque and force versus magnet coverage, the ratio of the magnet width to pole pitch (

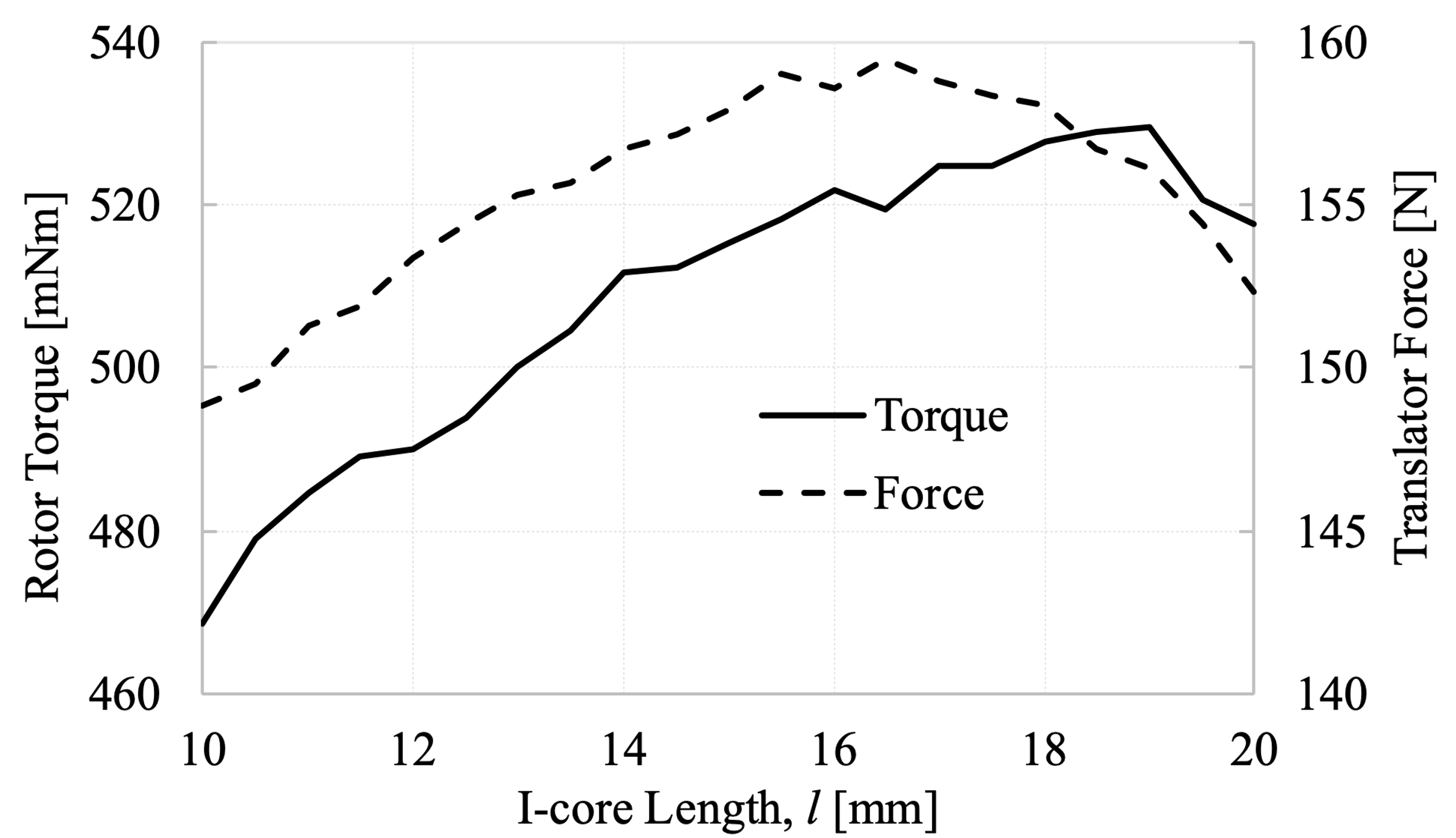
).



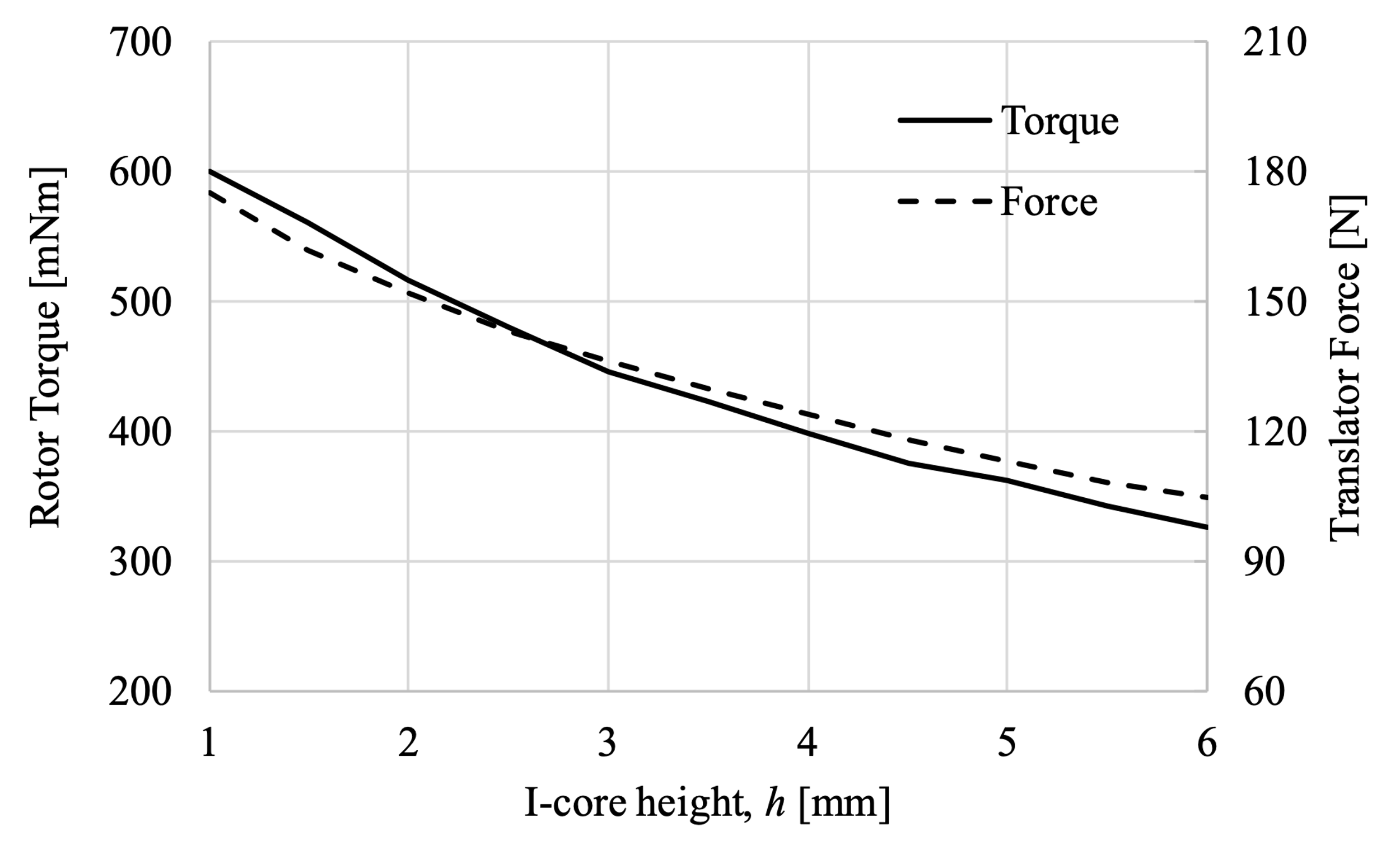
**Fig. 13.** Pull-out torque and force versus air gap ().



**Fig. 14.** Pull-out torque and force I-core thickness ().



**Fig. 15.** Pull-out torque and force I-core length ().



**Fig. 16.** Pull-out torque and force I-core height ().

Fig. 17 shows torque and force ripple estimated using 3D FEA when the initial rotor angle is 50 degrees, and the initial translator position is zero. Subsequent rotor and translator positions were kept in accordance with the gear ratio of 20 mm per revolution as calculated using equation (1). The torque and force ripple are significant, at about 30% and 40% of the mean values, respectively. Clearly, there is room for improvement here by optimising the I-cores dimensions and possibly increasing the number of translator sides, for example – see the discussion section.

TABLE I

Principal Dimensions of the Demonstrator

|  |  |  |
| --- | --- | --- |
| Parameters | Symbol | Value |
| Magnet width | *w* | 10 mm |
| Magnet thickness (on translator) | *d* | 5 mm |
| I-core height | *h* | 2 mm |
| I-core and translator width | *l* | 20 mm |
| I-core thickness | *t* | 6 mm |
| Inner and outer core-backs thickness | *hc* | 8 mm |
| Air gap length | *g* | 1 mm |
| Translator active length | *LT* | 40 mm |
| Rotor length |  | 100 mm |
| Rotor diameter | *D* | 30 mm |
| Pole pitch |  | 10 mm |
| Magnet coercivity |  | 838 kA/m |
| Magnet remanent flux density |  | 1.23 T |
| Number of rotor peripheral pole pairs |  | 1 |
| Number of rotor peripheral I-cores (and slots) per peripheral pole |  | 2 |
| Number of translator and rotor axial poles in active section |  | 4 |
| Number of I-cores per pole in the axial direction |  | 1 |

Chart

Description automatically generated

**Fig. 17.** Torque and force ripple calculated using 3D FEA of a magnetic gear with the dimensions shown in Table I. The initial rotor angle is set to 50 degrees; the rotor and translator are subsequently advanced in accordance with the gear ratio or 20 mm per rotor revolution.

# IV. Demonstrator

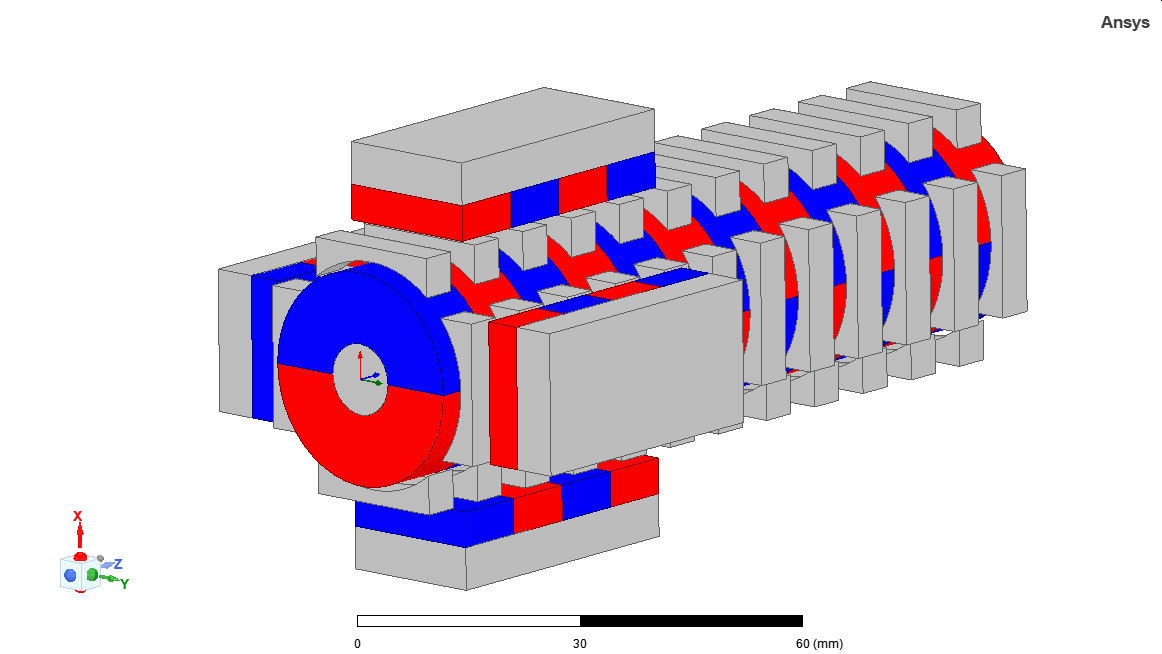
To validate the concept and investigate practical implementation aspects, an experimental demonstrator as shown in Fig. 18 was designed and constructed using off-the-shelf magnets. A solid model of the demonstrator without the frame, non-magnetic I-core spacers and bolts is shown in Fig. 19. The dimensions of the demonstrator are as shown in Table 1, but the magnet thickness on the rotor was selected to be 10 mm to avoid machining the available off-the-shelf magnets. The rotor shaft and translator’s back of core were made of steel 1020. The four active parts of the translator were held together using aluminium end plates that also hold the slider bearings.

To enable high-speed operation, the I-cores need to be laminated or be made of soft magnetic composites and separated by a non-conducting material. But in the demonstrator, which was designed to verify low speed operation and measure its static force and torque characteristics to validate the FEA, the I-cores were made of mild steel 1020 and separated by aluminium plates; the stack is held together by four bolts.

![A screenshot of a video game

Description automatically generated with low confidence](data:image/jpeg;base64,/9j/4AAQSkZJRgABAQEAeAB4AAD/4RDoRXhpZgAATU0AKgAAAAgABAE7AAIAAAAKAAAISodpAAQAAAABAAAIVJydAAEAAAAUAAAQzOocAAcAAAgMAAAAPgAAAAAc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAExhbmcgVC5WLgAABZADAAIAAAAUAAAQopAEAAIAAAAUAAAQtpKRAAIAAAADMTUAAJKSAAIAAAADMTUAAOocAAcAAAgMAAAIlgAAAAAc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAADIwMTk6MDM6MDMgMTk6NDU6NDAAMjAxOTowMzowMyAxOTo0NTo0MAAAAEwAYQBuAGcAIABUAC4AVgAuAAAA/+ELHGh0dHA6Ly9ucy5hZG9iZS5jb20veGFwLzEuMC8APD94cGFja2V0IGJlZ2luPSfvu78nIGlkPSdXNU0wTXBDZWhpSHpyZVN6TlRjemtjOWQnPz4NCjx4OnhtcG1ldGEgeG1sbnM6eD0iYWRvYmU6bnM6bWV0YS8iPjxyZGY6UkRGIHhtbG5zOnJkZj0iaHR0cDovL3d3dy53My5vcmcvMTk5OS8wMi8yMi1yZGYtc3ludGF4LW5zIyI+PHJkZjpEZXNjcmlwdGlvbiByZGY6YWJvdXQ9InV1aWQ6ZmFmNWJkZDUtYmEzZC0xMWRhLWFkMzEtZDMzZDc1MTgyZjFiIiB4bWxuczpkYz0iaHR0cDovL3B1cmwub3JnL2RjL2VsZW1lbnRzLzEuMS8iLz48cmRmOkRlc2NyaXB0aW9uIHJkZjphYm91dD0idXVpZDpmYWY1YmRkNS1iYTNkLTExZGEtYWQzMS1kMzNkNzUxODJmMWIiIHhtbG5zOnhtcD0iaHR0cDovL25zLmFkb2JlLmNvbS94YXAvMS4wLyI+PHhtcDpDcmVhdGVEYXRlPjIwMTktMDMtMDNUMTk6NDU6NDAuMTQ3PC94bXA6Q3JlYXRlRGF0ZT48L3JkZjpEZXNjcmlwdGlvbj48cmRmOkRlc2NyaXB0aW9uIHJkZjphYm91dD0idXVpZDpmYWY1YmRkNS1iYTNkLTExZGEtYWQzMS1kMzNkNzUxODJmMWIiIHhtbG5zOmRjPSJodHRwOi8vcHVybC5vcmcvZGMvZWxlbWVudHMvMS4xLyI+PGRjOmNyZWF0b3I+PHJkZjpTZXEgeG1sbnM6cmRmPSJodHRwOi8vd3d3LnczLm9yZy8xOTk5LzAyLzIyLXJkZi1zeW50YXgtbnMjIj48cmRmOmxpPkxhbmcgVC5WLjwvcmRmOmxpPjwvcmRmOlNlcT4NCgkJCTwvZGM6Y3JlYXRvcj48L3JkZjpEZXNjcmlwdGlvbj48L3JkZjpSREY+PC94OnhtcG1ldGE+DQogICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgCiAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAKICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgIAogICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgCiAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAKICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgIAogICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgCiAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAKICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgIAogICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgCiAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAKICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgIAogICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgCiAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAKICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgIAogICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgCiAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAKICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgIAogICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgCiAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAKICAgICAgICAgICAgICAgICAgICAgICAgICAgIDw/eHBhY2tldCBlbmQ9J3cnPz7/2wBDAAcFBQYFBAcGBQYIBwcIChELCgkJChUPEAwRGBUaGRgVGBcbHichGx0lHRcYIi4iJSgpKywrGiAvMy8qMicqKyr/2wBDAQcICAoJChQLCxQqHBgcKioqKioqKioqKioqKioqKioqKioqKioqKioqKioqKioqKioqKioqKioqKioqKioqKir/wAARCAG5Ay4DASIAAhEBAxEB/8QAHwAAAQUBAQEBAQEAAAAAAAAAAAECAwQFBgcICQoL/8QAtRAAAgEDAwIEAwUFBAQAAAF9AQIDAAQRBRIhMUEGE1FhByJxFDKBkaEII0KxwRVS0fAkM2JyggkKFhcYGRolJicoKSo0NTY3ODk6Q0RFRkdISUpTVFVWV1hZWmNkZWZnaGlqc3R1dnd4eXqDhIWGh4iJipKTlJWWl5iZmqKjpKWmp6ipqrKztLW2t7i5usLDxMXGx8jJytLT1NXW19jZ2uHi4+Tl5ufo6erx8vP09fb3+Pn6/8QAHwEAAwEBAQEBAQEBAQAAAAAAAAECAwQFBgcICQoL/8QAtREAAgECBAQDBAcFBAQAAQJ3AAECAxEEBSExBhJBUQdhcRMiMoEIFEKRobHBCSMzUvAVYnLRChYkNOEl8RcYGRomJygpKjU2Nzg5OkNERUZHSElKU1RVVldYWVpjZGVmZ2hpanN0dXZ3eHl6goOEhYaHiImKkpOUlZaXmJmaoqOkpaanqKmqsrO0tba3uLm6wsPExcbHyMnK0tPU1dbX2Nna4uPk5ebn6Onq8vP09fb3+Pn6/9oADAMBAAIRAxEAPwD6RooooAKKKzvEOoXek+G9Q1DTbCTUru2t3lhs4vvTOBkKMc8n0yfSgDRorxnxb4l8Z+E/hRbeM77xH9n1llhll0O7s4EgJkZQYlXaJgVDZPzk/KenboPH/jTxFpnwli8W+FItNw1lFdzNdOzlFk2Y8sAYY/OTkkDgcHNAHo1FeOXOr/EfUPg7a+LrLxDY6a9rpK38sX2FJpL7bFvcuxwse7BwqqfqM4HUeH/iMt/8Eo/Hd/bAtHYSzzwQ8BpIyysFz0BZDj0zQB3dV743gsZTpiQPd7f3QuGKx59yATj6CvM7PUvGesfCs+N7bxEttfSWT38WmLZxGzCKCwjJK+aSVGN28c9q3vhT4p1jxt4KtfEWrz2JW8DBLe1snhMLI7IwLNK+8HbwQF9/QAGX8HvGHiLxaviX/hKntvtOm6o1msVpHtjj2jDBSeSMgnJJNelV5D8C2CX3xBZjhV8SXBJPYZNSWHxJ0/xjo8+ox/EPTfCYeaRLG286187YrFVedZwT8xG4Ku3CkcnOaAPWqK83+DXxIufH+k6nb6t9mbU9HuBBPNaH91cKd2yRfrsb24z3wO/1HULbSdLutQv5RFa2kLTTSH+FFGSfyFAC6gb0WEp0pLd7vb+6FyzLHn/aKgnH0/TrXnfwY8Z+IfGNv4ifxTLbNcWGpG1SO1j2RxhV5C5+YjOTliTWh4ZuvE3jbw/D4lj1l9EhvN0un2EVrFIvk5+QzlwWYsBkhGTAOM55rj/2d2u/7O8atIkP2z+2pSyBiI/Mx0zgnbnvjpQB6XpVn4qi8Z6vc6tqdnPoEqINOtIosSwsB8xZsDOee5/DpXQ15h8P/GHirWfip4r8P+KWsUTSI4vJhsUOwbiSG3N8xJUr149qtaP4rn8XeOfEOjw+JDo8+i3fkQadDFCz3CBRmV/MViyliRhCpAAyeRQB6LRXFXfi6/8AB3wvvvEHjZI5L2xkuFZLdDGs/wDpDpAFBJKhl8vqSQDk5rP8QR/EG28DPr+lauZ9dihW4OjQWcT2sgyC0S5UylgpOCH+YjgDOKAPRaKzvD2oXereG9P1DUbCTTru5t0lmtJfvQuRkqc88H1wfUCtGgAooooAKKKKACiiigAooooAKKKKACqGta1ZaBpjX+pSbIQ6RjGMs7sFVRnqSSKv14X+0Np1wdS8I3S6xqCRzaxFCtqrR+TCeP3irsyX92LAc4GCaAPdKK8v+Kmu+L/h58O59T0TU4dR8l1E15qiIZ13sFARIo0j4JBywPfg8Vf8NL8QdSvdA1681jT/AOxbiwV7zSvswE24x5VhIOC5YgkAqq5wA2M0Aeg0V5Mms+NL74d6r4t1rV5/CN5AZ5LTSprWEQqqZ2LKZULsWx1Vl65Arb8I+Mtf8Y/Buy8SaXb6cuszxSbo7h3EAeN3QnC5bnYDtz360Ad9RXjHw38SfEP4mfD6e+h1uw0ec3kqC+Nis7AAAiNI8hVUZ+824nPTjJ3fhL491XxL4O1iTxMsUup6Fdy2txLAu0XGxc7sYwCeRxxxnAzigD0quF+LniPxN4T8C3eteFotPb7Koa4e7LF1Usqgog4J+Yk5I6dDWR4Y8R67418AS+JvDPieCfV2gdhpBt4mtreUZIhYACbd0G4vg/e24OK0PjOXb4F6+Zc7zZoWyMc70zQB03grULrV/APh/UtQl867vNMtp55NoXe7xKzHAAAySeAMVt15vb63rXh/9nfQtQ8MaRJq+qJotilvbRoX5aJF3FV5IXOSB6duoxfiD4t8RfDK10DU5vFI1Rry9jgvtNvoLeMBGUl3j8tFdQu3GWLY3Ln3APVNa1ez0DQ7zVtTk8u0soWmlbvtUZwPUnoB3NXIpBLCki5AdQwz714r+0/ZTn4cR3q6pexwrdxRNYoyCCTO47mG3cxGBgFsDrjPNdnrviJfhl8OLnXNY1S+1oxonkR3QhRmdgAsamKNBjPJJBIAP0oA7miuFv8ATPHieGW1S08SqdcSDzjpv2KL7E7gZMQ+XzR/d3eZ15x2rO0n4l6l4w+D03irwla2EepWscv2u3vpHKQvGhZgNoy2RtIBI4bk8UAel0V4x4F1j4m+P/Aeja9Ya9pti32x/tMc9mrfa4hKQ3IHyAL8oUDcSuS4zXs9ABRRRQAUUUUAFFFFABWdrlzrFpYeboGm2upXCn5oLm8NtlcH7rCN8nOBggD3rRooA81+F3xS1b4mwzXtv4ZtdO0y3n8iaeTVDJJu27vljEIz1Xqy9e+MV6VXhf7KX/JO9X/7Crf+io690oAKK5vxV4t/sG90rSbC3W91rWZmisrZ5Ni4Rd0kjtgkKq8nAJPAHqOe1rxr4j8G+MtA07xFa2ep6Xr1x9liu9OtJIWtZSRtV1Z3DA56gqcKxxxigD0WiuT13xhLB4wsvCXh+GG41m6ga6me4Y+VZ24OPMYDliWwAgIz1JA64+rePNY8DeJdKsfHEdhcaVq0v2eHVrCJ4BBN2SSJ3fAP94N68cUAeiUV5j8SfijrXgjxHounWvhvzrTU7xIFvZJg5kG5d6xxKc7sNgFiOexFakPirxToTa/qfxA0zTNP0CwtxcWtzY3BldvWNgcFm6DO1RkgDPUAHdUV594k8SeNtG8HSeK4bPR/s1tB9quNHmWTz1ixkgXAfbvA5I8sjggE8Zkuvinp7fDPS/FumohTVZ4bWBLl9iQyu+w+Y3ZUIbJHXbx1oA72iuW/tDxTpuuaNZ6kmm6jZ6jcSRTXlpDJAbbEEkijy2d9wJTG7cPTbzx1NABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQBwnjP4p2vg/xJpOiSaPqFzPql3FbJcGMxW6l2UEiQj5iA4OFB6YJFd3XkXx2/5CPw/wD+xlt/5ivQvE/imz8L2ts1zHNdXV7OttZWduAZbmVuirkgADqWJAAGTQBt0Vwmu/EO/wDBptrrxp4fSy0m4mEJ1CwvTdLbsfu+cpjQqD6ruGePTOt4x8caf4P0qyupke8n1K5jtbC3gIzcSv8AdG48Be5Y/rwKAOlorhJ/iHe6J400bw74t0KKxfXCyWN1Y3xuoy64yr7o42U/Mo4BHzD3xveJvFdr4caxtvJkvdT1KbyLGwgIEk7AZY5JwqKOWY8Ae5AIBgfEP4p2vw/ks4Z9G1C+lvJlijlVPLtwx7GU98ZOAD0PSu8r5/8A2gNS1ibRfDlprmjR2TnWopYprW7NzCwCsCrMUQq/zDjaQRnBODX0BQAUVj+JfE1l4Y0+K4vFkmmuZltrS1gAMtzM33Y0BIGT6kgAAkkVzet/Ee68I6zpVv4x0SKx0/Vp/s8F9a332gRSdhKpjTbnPVSw4PpQB3lFYuseJI9O1Wz0e0t2vtWvUeSG2VgoWNcbpJG/gQEgZwSSQADWBa/EeS08eW/hHxdo66RqF9GZLCeC6+0210BnKhyiENweCv8AMZAE1b4o2umfEfSfB/8AY+oNcajKUF3NH5UIAByUJGXwR2AHPWk+IfxStPh/JZw3Gj6hey3kqxRyJHstwzdjKeM4ycAE8dq534l/8l4+GP8A11u//QUqP9pP/kSPD/8A2MVt/wCi5qAPYaKKKACiiigAooooAK5X4ma/qXhf4a63rOhw+bfWlvuiG3dsywUvjuFBLf8AAa6qkZVdCjqGVhggjIIoA+cPF2reF9T/AGcb6fTtQTWPEd9aWkuoXDN510jefG7iUjJiQHcAvCjgCuj1/VtPvP2Qh9lvIZRDodlbyMjgqsoEQMeem4EYI6g8GvWrbw1oVlp1xYWei6db2d1nz7aK0RY5c9dygYb8aivPCHhrUbS1tdQ8PaVdW9mpW2hnso3SAHGQilcKDgdPQUAcLaSxn9k9mEi7f+ESkXO7jP2YjH1zx9aofCa80u3/AGWYJtajFzp1vZ3xvYVG4snnTFlx6lT+or0X/hCPCn9mHTv+EY0b7CZvPNr/AGfF5XmY279m3G7HGcZxxXP+MtJ/4Q3wFq118OPC1jFqUqIrx6dZRo7R7sMwVQN7KpYgc8noehAOG8J3mjj4a2+hD4o6Hp2k31s2+zmmia8so5ckwLM0qgbQ23LRkjnGOMes+D7Xw/p/hKysvCNxbT6Tap5cMltOsqnnJJYEgkkkk+pryzTfF3wMdYrGTw3Y21+qhDY3XhtpLkMB91sRNlvfJz612nhDwpphuNavIPD0WlaHq0UMSaRNbqiS7N5aZ4MYQuHVdpGcRgkAnAAOP+B8ltqp+I1tb3Mb/adbuGBRgTsfcFf6HnB9qwvhX8VdM+GujzeA/iKs2kXWjzyrFP5DyJIrOX6KpbqxIOMEEV7dpvg3wxo16t5o/hzSbC6UELPa2MUTgHggMqg81Y1Pw5omtyRyazo2n6g8RzG13apKU+hYHFAGf4R8XQeM4LnUtIikOjqyx2tzLE0bXLDJdlVsHYMqASBkhval8f6PdeIPh5ruk6fg3V3YyxwgnG5ivAz7nj8a3440ijWOJFRFGFVRgAegFOoA8d+D/wAU/DqfD2x0XxDqMOkavo0Ys5rO8by5H2HauxTyxIwNoG7ORjpnK/Z416xbV/GGllpkvbjWJLlIWgfhDnljjCn5SMEjnivZpPD2iy6wmrS6RYPqSfdvGtkMy/R8bh+dT22mWFnbSW9nY21vBKWaSKKFVVyxyxIAwc5OfXNAHkvw/vbab9pL4iJFcRuzxW4VQwy2xVV8fQ8H0q14g8DeB/irqWp3EM50nxNpV08E13ZyhZo2jOEd1/iBABB4PYNxXeWngTwjp95Fd2HhXRbW5hYPFNDp0SOjDoQwXIPuKt6j4a0LVwg1bRdOvhG5dBc2iSbWJJJG4HBJJOfegDw17Dxb45/Zs17TtQlbVr7TNQdLG7GWbUIIHXLDqXPDgHq2AOvJ6Dwf+0X4NuvC1kPEd7Lp+rxxrFPbC0lk8xwMZQopGD6Egjp717HHGkUaxxIqIowqqMAD0ArOXw1oSawdWTRdOXUj1vBaIJj/AMDxu/WgCTRL261HRba9vrVrOW4UyC3kGHiQklFcdmC7dw9c1foooAKKKKACiiigAooooAKKKKACiiigArxn9ot1trDwfeznZbW+vRNLKeiDBOT+AP5V7NVe/wBOstVsns9Us7e9tZPvwXESyI31VgQaAPJ/jtr+k638B9XuNI1CC8t2uYIkmhfckjCVCQjdHwM525xgjqDXe+H7x4Phfpl5ZRi6ki0eKSKNDnzWEIIUH3IxVu+8IeGtUit49S8PaVeR2qeXbpcWUcghX+6oK/KPYVa0nQ9J0G3e30PS7LTYZH3vHZ26QqzYxkhQATgAZ9qAPDfB3i7QvE3wy1XWPEepR6p4yuoLtPsjjzJrf5WCLBCOUTbtJZR1yWPFb3wB1fTz8DYLQXkJntEuXuUDj9wDI5G/+7kHIzjI5r1K00DR7C8ubuw0mxtrm6ObieG2RHm/3mAy341CfCvh46Q2lHQdMOnM/mNZ/Y4/JLZzuKY25zznFAHmX7MMiH4ROodSU1GbcAfu/Kh59KpfAXUYIbDx/PG8c5i1ea48tXHzLgkH6HB5r1W18FeFbGK4isvDOj20d1H5VwkNhEgmTrtYBfmHseKLDwV4V0u5+0aZ4Z0ezn2snm29hFG20jBGQoOCOCKAPHPFngPwpceE7n4mfDLW38P3sFs14GsZsRTEDcYimfkYkbdo4zwVNdJ8RNVvbv8AZfur/wARotrqN3ptuZ4yu3967Jxt7Ek9O34V6PL4Z0GfVU1ObRNOk1CP7l29pGZV+j4yPzpdX8OaH4g8n+3tG0/U/I3eV9ttUm8vdjO3cDjOBnHoKAPJvE3jDVPCf7MPhjUvDjsssljYWst3Eoc2qGEB3APGcqE56Fq5H45XPhGb4SafF4MuodSb+1IZbq9iczyOfIlAM83J3nI4Y59sCvoaz8M6Dp2mz6dp+iada2NwSZrWC0jSKUkYO5AMHgAc+lH/AAjOhf2N/ZH9iad/Zmd32L7Ink5znOzG3rz0oA8r/aJvLfW/ggb/AEmZLy0F/C/2iE7kZfmXcG6EZYDI4o+L1tb/ABL+DDjwbdpq8ukywXjJZN5gfCMrJkcFgrlio+YYHHIz7BNZWtxYtZXFtDLasnltA8YZCvTaVPGPaksbCz0yzjtNNtILO2jGEht4xGiD2UcCgDA8OePNF1zwDB4oN9DDaC38y6MjgfZ3A+dG9CCD9e3UV598OPDdz4V+AfiS61mI2Mmqx3l/5E3yGCNotqK3ocLn2zjtXqQ8K+Hhqp1QaDpg1AnJuxZx+bn134z+tWNV0XStetVtdc0yz1K3RxIsV5brMisAQGAYEZwSM+5oA89/Z0ZW+COkhWBKy3AYA9D5zn+or1CsrSfC3h/QZ3m0LQtM02WRdjyWdnHCzLnOCVAyM9q1aACiiigAooooAKKKKACgkAEk4A6k0Vna3oVl4hsfsepG68jOSttezWxbgjDGJlLDB6Eke1AHjn7KX/JO9X/7Crf+io6t3PwS8az3Ussfxk16JJHLLGqzYQE5wP8ASO1d54a+F/hPwdefafDVjdae5O5kj1K5MchwR80ZkKt17g4rraAPCPifdz/D74nfDvxRq8k99pthbvYXV0VJO8oUaQjJ+Yq5bHJOw9cV6W/xN8JTRQrpGvafql5dOsdtZ2lysksjsQANq5ZRzkkjgAk9K39X0bTtf0uXTtasob6zmxvhnQMpxyD9QeQeorD8L/DPwd4Mu3uvDehW9ncsCPPLPLIAeoDOSVHsMUAee+Y/hn9rqa61eQpa+I9KFtYSOCE3qIsxg9M7ojx6uvqK0P2idMfX/BWj6FZR+dqWoazDHaIBkg7H3Nx0UKTk9hXpGveG9H8T2As9e0+G9gVw6CQENGw6MrDBU+4INRaX4V0jR7pbm0gllukQxpc3l1LdSohxlVeVmYKcDgHHAoA8t+OqeX4i+GiFi23XIxk9/nirqPjrpd5q/wAF9et9ORpJUSOdo16skcqu35KpP4VreIvhl4V8WatHqfiCxury6hIaFjqVyiwkAcxosgVPugnaBkjJ55rpLKyisLGO0gaZ4oxgG4nedz9Xclm/EmgDx7wd4h+CviDwra3t9pnhDTLxYgLm1vrS2idJAPmxuA3DPQjOfrxXU3mn+CvE3w5sdKvNLh0/QNXujFYRwRrbqGJdo5VAACb9u4cc7wCOSKtTfBv4fT62dWl8LWRui24gbhET1yYgdh/75rptV0HStcsY7PWNPt721jcOkMyBkDAEA46cAnHp17UAeNQ6d4v+DHi7w9Y2muzeIfCmsX8enpZ3YzPaluBtPooBPGF4IKjg17rWHYeDtE07UEvoreaa5iz5Ml5eTXJgz18vzXby8jj5ccVuUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFAHkXx2/wCQj8P/APsZbf8AmKrfE66fTPj98OL+/ONMLzW6MR8qzP8AJz6fej/L2rr/ABr8LrHx3qtlfarr2tW39nyCW0gs5IUSGTj5xmIsTlQeScdsVsa54N0rxR4YXQ/E6yatCuD58+1Zd46SAxhQre6gdxjBoAw/jXFbS/BfxIL3b5a2oZd398OpT8d2K5W415vCnw4+HPh/UNMs7vxDqYt4LH+04wY7KUKo81gedyeYowCGOcA13kHgS2aC2t9a1jVddtLWRZIbbUZI2QMvKltiKZMHB/eFuQD1FO8c/D/RfiBptvaa39oie1l862urSTy5oG9VYgjnjqD0HcCgDyj4sWFzpnxU+Fb3Wr3WoXc2sYkkkYIqjz7fhI1wFHzEdyRjJOK2vE2qjS/2rPDJ1dvLsbjSHt7OSQ4jSZmkzg/3jhV/4EtdHqnwX8Navb6UL261d7zS5xPHqRv2a7lYY4eVstjKgjbtxjjFbHi34ceG/GmhQaXrdmxjtebaaKQrLAcclX5Jz3znJ5OaAPP/ANpd1Xwv4a3MB/xPYjyewR8mvaa83uvgZ4Y1PS7Wx1291vWBbTiYT3+oGWVwFI8vdj5U+bOE25IGScV3ul6XZaLpkOn6VbpbWkAxHEnQc5PXknJJyaAPJPjZrB8NfEL4d67f+YNHtL2cXLrnbGzBBuI7kLuI9lbFema1f+H5PDi6tq32O+02HbdQyMqzKzjlGjzkF8/dxzk8VL4l8M6R4v0OXSPEFmt3ZykEoSQVYdGUjkEeorh/CfwA8EeEdcj1a2hvL+6hfzIDfzK6wt2KqqqCR2LZweetAHMeLLvTdP8A2nLU+LLq8sLDUdCW1tLmC+mtAsnm7trSRMpxkMME4yyk9q7jUvA3gi11nRtV1OO9vdRiu4hpj3OsXVw4kLAgoHlOQMbiORtUkggVr+Nfh/4e+IGmx2fiSzMvkktBPG2yWEnrtb34yDkHA44rF8CfBfwl8Pr86hpEVzdX+0qt1eyB3jU9QoVVUZHGcZx3oAwfiX/yXj4Y/wDXW7/9BSo/2k/+RI8P/wDYxW3/AKLmrpvEnwqs/E/i+z8SXniPXre+09t1kttJAsdtznCgwnOT13E56Hjin+OPhdZfEGCyg17XtaS3s9rxxWrwRhpQCPNJ8oncQexAHYCgDuKKq6bZy2GnRW1xf3OoyRgg3N0IxJJySN2xVXgccKOnOTk1aoAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigChfap9i1PT7Qw7lvXdPM3Y2ELkcY5zV+sDxT+6k0a5/556jGCfRWyDW/WkopRi0Zxk3KSYUUUVmaBRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFAGfouqf2vpoujD5LeY8bR7t20qxHXArQrn/C37mfWbT/AJ5ag7KPRWAIroK0qxUZtLYzpycoJsKKKKzNAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACsuXU5ovFFvpxVPIntmkDYO7eD09MYrUrn9c/c+JtAueg82SE++9OP5VrSSlKz7P8jOo2ldd1+Z0FFFFZGgUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABWfouqf2xpoujD5LeY6NHu3bSrEdcCtCuf8AC37mfWbT/nlqEjKPRWAIrSMU4SfVWM5Saml3udBRRRWZoFFFFABRRRQAUUUUAFFcrrN3dRavMkVxKijbhVcgD5RVL7def8/c/wD39NTzF8h29FcR9uvf+fuf/v6f8aX7def8/c//AH8P+NHMHIdtRXE/brz/AJ+5/wDv4aPt15/z9z/9/DRzBynbUVxP268/5+5/+/ppft15/wA/U/8A38P+NHMHKdrRXFfbbz/n7n/7+n/Gj7bef8/c/wD38NHMLlO1ori/tt5/z9z/APfw0fbbv/n7n/7+GjmDlNXxqCvheWdetvLHKPwcf41vgggEcg9K8+1i4uZ9Hu45LiV1MZJVnJBxz/Sp7PULuSxgcXU2GjU/6w+lbOV6S9X+hilaq/Rfqd1RXF/bbz/n6n/7+Gj7def8/U//AH8NY8xrY7SiuL+23n/P3P8A9/D/AI0fbbz/AJ+5v+/ho5gsdpRXF/brv/n6n/7+Gj7bef8AP1P/AN/DRzBY7SiuL+23f/P1P/38P+NH268/5+p/+/ho5gsdpRXFfbrz/n7n/wC/hpwvbsf8vU3/AH8NHMFjs6K437bd/wDP1N/38NH227/5+pv+/ho5gsdlRXG/bbv/AJ+pv+/ho+23f/P1N/38NHMB2VFcb9tu/wDn6m/7+Gl+23f/AD9Tf9/DRzCOxorjvtt3/wA/U3/fw0fbbv8A5+pv+/ho5gOxorjvtt3/AM/M3/fw0fbbv/n6m/7+GjmA7GiuO+23f/P1N/38NH227/5+pv8Av4aOYDsaK477bd/8/U3/AH8NL9tu/wDn6m/7+GjmA7CiuP8Att3/AM/U3/fw0fbbv/n6m/7+GjmA0NN/ceONZh7TwwzAfQFTXQV53LdXEfimCXz5A81s0e7ecnB3YrVF5d/8/M3/AH8NbVXs+6X+X6GVLS683/mdfRXIfbLr/n5m/wC/hpftl1/z8zf9/DWNzU66iuR+2XX/AD8zf9/DS/bLr/n5m/7+Gi4HW0VyX2y6/wCfmb/v4aPtd1/z8zf9/DRcDraK5P7Xdf8APzN/38NL9ruv+fmb/vs0XA6uiuU+13P/AD8y/wDfw0v2u6/5+Jv++zRcDqqK5b7Vc/8APxN/32aPtVz/AM/Ev/fZouB1NFcv9quf+fiX/vs0v2q5/wCfiX/vs0XA6eiuY+1XP/PxL/32aPtVz/z8S/8AfZo5gOnormPtVz/z8S/99ml+1XP/AD8S/wDfZo5gOmrn/GH7vTrK7/59b6GUn2zj+tQ/arn/AJ+Jf++zWb4hee48P3aPLIwCbsFiehB/pWtGS9pH1MqyvTZ3FFcrb31xNaxS/aJfnQN989xUv2m4/wCe8v8A32azbs7Gq1VzpaK5r7Tcf8/Ev/fZo+1XH/PeX/vs0uYDpaK5v7Vcf895f++zSfabj/nvL/32aOYDpaK5v7Tcf895f++zQLm4/wCe8v8A32aOYDpKK5v7Tcf895f++zR9quP+e8n/AH2aLgdJRXOfabjH+vl/77NRfarn/n4l/wC+zRzAdRRXL/a7n/n4l/77NH2q5/5+Jf8Avs0cw7HUUVy/2q5/5+Jf++zR9quf+fiX/vs0cwWOoorl/tVz/wA/Ev8A32aBdXP/AD8S/wDfZo5gsdRRXMfarn/n4l/77NJ9quf+fiX/AL7NHMFjqKK5j7Vc4/4+Jf8Avs0n2u5z/wAfEv8A32aOYdjqKK5f7Vc/8/Ev/fZo+1XP/PxL/wB9mjmDlOoorl/tVz/z8S/99msubxfYQTGKXWVDg4I80n+VHMHKd5RXBjxfYE8ayP8Av41Sr4ltHbausR5Jxg3GP60cwcp29FeL6h8QtaS5mXT7mNwrnYrFjuX8+taek+LNW1XTftUesQIY+J42hfMR98P0961jBuPP0M3JKXKeq1z+m/uPHGsw9p4oZgPoCprmbXWNdu3Kxala+xaOUZ/8erO1HWb/AEjXFu9Q1Kzt5Gt/LaaTzFQLuyMnOc596unb3ot9P+D+hFT7MvP/AIB6vRXkUvxHSKRFPiXSm39CjzMB9SOlath4puNQIFtr+lTE9BHcvn8iawuu5tY9IorhLvUPENnbtcfu7tE5aOCZw5XuRngn2qxp+uHVLJLqzu5Xjb1cgqfQjsaOnMtgsr2Ozorn9MuJ31GJZJpGU5yC5IPBroKE7g1YKKKKYjk9aXOsT/8AAf8A0EVRxWlrAzq03/Af/QRVHb6Vk9zdbEe2l21Jto20AR7aAtSBaNtAiPb6Uu3NSYpdtAEW2jbUm2lC0hEW2jbipdtGM0xFeeLzLaRMfeUr+lVNEbzdFtj/ALGPyOP6VpYrM0AY0+SL/nlO6fTnP9a2jrSl6r9TGWlVej/Qv7aCtSbaNtYmpHtpNtSEUYoAZijFSAUm2mIZikxzUmKMUAR4pwFKBTgKAG4oxT8UbaBDMUYp+KMUANxRin7aMUAM20Yp+KMUAMxRin4oxSEM20bafijFMBm2jbT8UYoAZtoxT8UuKAMjVB5eoabN6TGP/voY/pWoBWd4gGzTVm/54TJJ+uP61qY71tPWnF+q/X9TGOlSS9H+n6DcUu2nYpcVibDAKXFOxRigQ3FLtp2KXFAxuKAKeBRigBuKgiv7OZsRXdu59FlUn+dWW4Uk9hXgWoiDT9WlMnWK5bA47MR+VAHvoFLikiYSQpIv3WUMPoRUgHNADcUYp+KMUAM28UYp4FLigBmKMU/FG2gBmKju4fOspov+ekbL+YqfFLimnZ3E1dWMzQZPO0GzbriML+XH9K0cVl+HBs0+a3/597mSPHpzn+ta+K1rK1SXqRSd6cRmKMU/FGKxNBmKMU/FLigYzFGKdijFADcUYp2KMUAJjg/SocVYAqIjmgBmKMU/FG2gBmKMU/FGKQxmKMU/FGKAGYox6U/FGKYxmKMU/FGKQxm2jGKfijFAzN1y6Nlol1Opw4Qqn+8eB/OvJp4yq7gM/wB4d/rXf+PLox2Nrax9ZJC7fQD/ABNcG7HnP3u1AEMTuzJtViG5VgOKsyTzMm3yGLr/ABBarEFCHU8Z7dqtx3Xm/KXO4etIDGuopC5l2eW/cDj8as6dfXFvdJeWLiK8Tgj+GYdwRWhMv2gEnqB0xWPcWzwN5kWcA8gVrTqODujKpTU1qelaXrMGu2f2i2EgngUeZabydjeuMjK/ypZL5NRfTriQLLEs7RfMgYHIxj0PTtXntleTC6jurKX7PfRjhh0l9j/nmuuj1221nTlmINveWjqZbXdheuNyj05/CuynTjKSlDbb0vp9xyznKMWpbrX1tqdGLbS7vzI3sbVoyNrq9oFI9c+1PgsNL0d1W1trC2UgAFIVDD+tNFxJINuWgcY2s4ByCPxH9adLZyXVt++iZSvQA479RjJ/CvO5VfU7bs0XknjO7cvlY+8F6fr0rAnsJ7fUnv8ARWWC7c/vLVxtjux6jng+9aEN5MsX7tSi52glCRn/AANOaNrmMo8L+WeVMZxt9wf6U4NwYSSkaPhXVoNVvEMYaKeIlZreTh4mweCP612NcHoNlHJ4osrqZP8ASoVZVnjYnzFKMMPwAf6EV3la+79kl36hRRRQI4fxH4j0TTtcuIL/AFazt5k27o5JgGXKgjI+nNYb+PvCkf3tctTj+6S38hXL/Ef4Y634j+I2p6nZvapbz+VsMkhB+WJFPAB7g1gR/BHWyP3l/Yr9GY/+y1GlzRXsd+3xL8Ipz/a6t/uxOf6VE3xT8JL01CRh7W7/AOFcenwOvz/rNXtx64jY1KPgbORzrMX4Qn/GloPU6tPin4Sc4/tCQe5gf/Cr1t498LXRxHrNupP/AD0yn8xXCH4HXQ+5rELfWJh/WqN58FtbgQtaXdrcn+7uKn9RRoK7PZbW8tL1A9lcw3C+sUgb+VT4xXzfe+FvFPhuTz5bK7g2c+fCSQPxWtjRPiv4g0tljvZF1CAHBWcfN+DDn880WC57xijFcv4d+ImheIdsaz/Y7s/8sJzjJ9m6H+ddWFpAN20mKkxUF5cxWVpJc3DbY41yT6+1IDK1/wAR2vh+FDcI00rglY0ODgdz6CuSHjaawsZ762t4tk8xl8uQkn5uoByPQdu9c54n1CbUtSF7JuBYkYB4A7Cmi5/4ltu0cUSkMV+5u5/HPXrWtN3hNeX6oxqfFF+f6M7mw8epcxD7TYtHLgEhJOMfjVz/AITK2/59Jf8AvoV5VYytb6ww5ZnyCK6PdhctxisjU6m78f2Vqp/0KZ5McKGFZo+I87AMmmK43YZd5BUeuf8A61cTfFo9VMxyVYA7CeDip7rUTdTSNb2ltaI4A8qBThfcZJ5+tJ3A9Ht/G9nPHn7LMp6MMg4NW4/E9tLMkaW8zM5AABFea6bcI8pihHCgZ+tdp4ZsSBJfSfdX5I/c9zRcDsRgjI70YqOzO62XPXpU+2qQhmKUClxTGnhRiHniVh1BcZFMB+KMUz7Rb/8APxF/32KX7RB/z3i/77FAh2KMU5SrDKEMPUHNLigBuKMU/FGKAGYoxT8VBe3UdhYXF3N/q4I2kb6AZoESYqrcajZWkqxXV3DDI3IV3AJ4J/8AZT+VchB8S0uY9yWManGSjSnI7+lec634nsrzxRe3moWK3PmsuxS/3FVl4Bx3C4+hNSB7h/belFdw1G3xjOfMHTbv/wDQeaf/AGrp2CRfW+FBJ/eDjABP5Ag/jXhUXiHQVdN+iIyqVJHm8thySOnQ5C/QUkWueHgkYm0lnZdm7E2A2C2fz3DP+6KV32HY95N/ZLuBvIBtzuzIOMEA/kSPzp32u1Bx9phyDgjeOu7b/wChcfXivBY9Z8NKq79NnY4UZE/XCkc/UkE/7tO/tvwvsAFheB8cn7R38vH/AKF831o5n2A96FzbtjbPESSAMOOedv8AMEfUUouIGwUmjbdjGHHOc4/PB/I14KNX8MfN/o9+vDbSs4yDsGD+By341M2reEzuKRapECX2hZwdvTZ3/hG7/vqjmfYVj2fWDFcaLdIkiNmIsMMDnA3D9BmrNlcJNp8EhdctGpILdPlB/lXiA1fwushaJtUTG4p+9Bx8w29+y7l/GrF/eaJb3rpe3GpJKQC4icbDkjOOehT5f/rVvzXo+j/Nf8Ay2q+q/L/hz28so/iXjrzSjHqPzrwdNW0MyATahqrKceYRJ1y539+6hB9R9KcNV0ciMnWNV3ZUyfOfUs5H1YIfwNYcxqe7/wCetH0rwyHV9LCwk+INWjf5S5znBALZHP8Az0Ofzp0WraapwnijU49g+Vih4Ij+Xv8A32b8DT5gse5gH0pQD6V4lJqemrGfsvjDUcgsqK0bDChQq/oXH5fWiTV7X94I/GF+Vy6gFG5G5UH5x5/EUcwWPbtvqK5zx3rN3oXhea4075bp2Ecbbc7c9wO5rzn+142k/wCR4u9rN8x8tuA0gDH/AL5AP14rP1W/+2KnmeJpdSZcOsLKQNxdt35YUj6npRzILESeNfHivh7q+Yq2CrWoOSOoPy1n3mojWZLi9eJI3mLMUzkJwM4/EGm/aplkLGRt33s7u/rSWNjNdidbWJnWNsMQPcg/zFUI6Gf4meIbRLe3tZIoIYYkiVfKDFtqgZJPc9a7H4c+Ob/xFf3On6uUeZY/OikRAvAOCpA+oOfrXld3JHpbRx39glw5AZknLAgjj+EjHSrek64wv4joaW+hzBGSS5DsdysR13E4Ix2FAz6MxxRivKBrmvtOVHjHT8En5uMDMwH/AKDz9Mip4tX8RHy2Pi/SgCVyGI4/eNnPHpj8CB2qOdDseoYpcV5Zb694mkjiY+J9JQsEJEjrkfKxOfxAB9yKkXW/FYg3jxHpDjZn/WpuP7rOPrnj60c8RWPUMUYrzN9c8Xjeqa1pEh+cArKgz8ikY/EnHvntUja14zVm26jo55fb+9Tsy4/QnHtk+lHPEdj0jFLj1rzQeI/GPnJGLzSSzPgAyKP+Wu38sH8uetSJr3jcTJEX0tmPl/8ALRP4iw559sn049cUc6Cx1+kfu9Y1eD0mWX/vpc/0rYxXl9t4g8TG5+0QJZteXEamQFl27AmQc9Afb1q+Nf8AHLRystjYMIw24iReCIw3rz1/Pit6048yd90vyMqS91rs3+Z6DijFedv4p8aRyvG2nWJdS42hgT8pX/a/2qnHiTxqZTGukWbEMRwTz+82evv+VY88e5qd9ijFefDxZ4xDqp0W2Ytjpn+8y56+1KPGHi87AdAhy+0Dkjkgn1/2SaOaPcD0DFGK88PjbxWEU/8ACPxDfjZndzlN47+gJpp8feJV3k+H4iF3EjLZACCQ9/7pz/nFF0B6LijFedSfEHxFBvM/h2MCMtvO5uAuC3f0Zaevj/xDv2t4Z3EMUO1j94NsI/76IougPQhUbDk1wkXxC1pwP+KYlbOBlWJ6kr6f3lP+eaRfiHqjgMvhi4IYjHzn+JSw7eit+VHMhnd4pcVwX/CyLwfe8N3HTd/rD027/wC7/d5qQ/Ea7Td5vhm8UJkt8x4wAx/h9CDRzIDuMUYrhm+JTx5Evh69UgkHLehAPbsSPzoHxM7Hw/e5zj73vt9P73FF0B3OKMVww+KERx/xIr47sYwRzkkDt6gj8KVfijZuM/2PfY4IIx35H5gH8qdxnc4oxXFf8LQ03+PTr5ffaPTPr6c07/hZ+kKcSWl8hHX92Dj9fcUAdnijFccPifoe7a8V6hzg5hHHOPX1p6/E3w+WwftYPvB+Hr60DOuxmkIrlR8SvDhGfOuB9YDS/wDCyfDXe6mA/wCuJ9M/yoAwvGl6JNfkTPy28ap+PU/z/SuWM0dwokicEjgrnOPrS6t4jtLi+lk2iVZnZ5HD4IyegHsDXpfw68J6BqHgm3uLq0ivZZJJMzSA7sBiAM/QCgd7Hl6TAMQ/HpRu2tmPGPbtUvivR4rHxVbm1Bhsp5mVo1JwuG7fhiuwtfDumggJC2MngsTuHvUN2GcaL1C5GSrr1xyDQ80M8ZcTJkdRmrer6LHY37LGC8LHCnd8yH+6f6GmW9rFEoZcNjs5zj86dxGLOFQ74mGOpwf1q9Yzx3VxE0h2XCHAbs49D74q1c2kUqb4UAXowHasqSH7PMroOAwrajUdOakjKrTVSDiz0PQ9estQfybq2/4mcDYwMZkH99ff2ra+0uG8mF5UJGV/iC/pnFeXXt3Cl8RIJEmiIaOaI4I7iry+NdWH/MUuPxhjP9K6K0afO7O3k/0MKMqnIm1c9Bhe6ZWiM8kdwRklACp9COMf41JFJcLOVDSPkZZ1UKpP0yTn8K84bxbfHk38jntvtozin/8ACX6hIx83USQeDutU/pWPJD+Zfj/ka80v5X+B6r4c+0f25G00wKu74VRwRtPX3rta8Y8BeIru98b6daPeLJEwkXyxbhMgRsRyPpXs9KyWzuNNvdWCiiigZg6kP+JjL+H8hVXFXNRH+nyfh/IVWrJ7m62I8UYp5FGKAGbcUYp+KMUCGbcgg9D1Fcr4g+HWga+rPJai1uW6T242nPuOhrrQKMUCPnjxN8Mtb8Obp7ZTf2a8+bAp3KP9peo+vSmeHPiTrnh8rC832y2XjyLkk4+jdRX0SRXLeIfh1oHiEtLNbfZrlufPt/lJPuOhp3JsZ2i/FXw/qiqt7I2mzdxNyh+jD+uKg8V66mozJbWcge2i+Yup4kb19wK5sfBy8sNbtpDdxXmnCUeYDlHx9O/boa7weCLMgEySe+DUyaQHnd5bxzRAMOhyMHFNigAsCgZ8LJnrz0r0Y+BbBuPNl+mao3fhC1tL6zt1lkMd07KxzyCBkVpQacmvJ/lcyrbJ+a/M4W2t44Zi6IMnqx6mr5ORWvqenaRY3BhglluHU4dg2FB9M96qRwW0kgREkLMcKN3WsjUxL22WV1c5BAxlTSJHkgLuOBjGetdbH4ehkQGXd6lVfkVpweCrNlWaKdsHkEn/AOtQI5PTNOIkjihjCvIwGMc5rvCqQRR20XCRjFMttJt9NLTtK7uuVXccj61GSWBJ71AzZ0/m3P1q1iqWkvujYHtWhitVsSzP1jUE0nR7m+kwfJTKqf4m6AficV5Lbbrq8ee7cv8AellOevc/qcfjXX/EHVIZFXTFZmkjZZGRehbHGfXA/nXP6Zo73+mgR31lbmaTYwmlwy4GR8oBOCf1qttxHNXl4/msEYrk5wDWz4et2vNzzkuOEUNzyep/AAn8qwLq3eK6AbaQejKchua6izu4NK0W4CzoL2K2aSOJjyWIznHfgKPzpvYR3ltGyRghyoxwVOK07C4klcpI27jIJrmB4n0q2gtor2/hjuWgR3hGWZcqDyADitXQdY07UbzbY3sM7BSSit8wH0PNZlHRYpMU7FLiqEMxXNeP7wWfhOePIDXTLCPx5P6A11BX2ry74q6pjVbCwVuIYzM492OB+gP50LcDiWKrM8pUMkKcKR1PYZrIuLaC5vZJRCse8HC8kL06ZOeK1ZHzar93Mr5JHovP86z2byTvx9O+B2qrCGG0jBbFtF37HjkH+WR+NMEFvn/j0iIz6n+9n/0Hj9aikvhkjzScnJqE3oI2hiB7GlYLlvZZjHmWMJGRkBmHck/pgfrURisht32cZ6A4dh65/Pj8qqtdr61H9rB78UuULl3ybPHzWak4HIkI/hOf1x+FM8my2kfZOcdfNP8Adx/Pn6cVWF0vr+tAuh6j86OULmunhyWdQYdMm24O3dLgHgY6++fwxWzqnhhtSuIpgiowgVW3ydGGOOBzxn9KZ4S10Tj+zrhxvUZhJPUf3fwrqq9zDYShUpXTbueRXxNWFSzS0PO9V0K10qZIpGaRnUsQrdBu4/TP41ni1tywO2QLxkB/c5/TH41a1vU0vNYnmByu7YnPYcf/AF6o/aV9cV5FVR52obHp03LkXNuSiyt1jBcS9s4Yehz/AE/WmCG22/MZcgc4bvt/+K/Sm/aAe/5Go2nj2/y5rOxoWBBalTtM3Q4+Yegx+uRStaQndsebvtBx7Yz+v5VDHcxgHGaQ3CBt2T9KVguTPbwKSDJN7dPUf0yaktbUnUIfsXnTs7bAhABJJP8ATmqMs4dsjjFanh7VYtK1SC+uF3xwschSM8gjge2adgudMfBvif7Gbh9I2xKCxzPHkge26sHSFlMLyThgzSMQpHU5r0K4+LuiHS/JthctJtxtaHGfxziuJt77+0LdbmWJFYg7ivHzFmJx+JNQr31GYmrMDdgLxlecYxnJqTRtJvNavPsmnRSTTFSwSMZOByfb866i28B+JtZtodQ0m3VrKcfITOqtwSDlT7ivQfhj4J1Xw/cXN9rypFKyGKGFWDFQSCzEjjnA4qrgeb/8K+14DP2a7Cjn/VdRw3r/AHfmx6jHXij/AIQTX0yWt7pcfe/dHjB5/Qhvxx1BFfR2KMUgPm8+BtfUDda3IIOCDEflwcH8iR+Y96b/AMIXrgwPs11u448g9eVA/wC+gV+vtzX0nijFAHzSfCWtkApbXByBtHktzlTgfjhh9QaD4U1oRljDMVBOMQtyNobI+q8/ga+lsUYoA+Z28NaujsGjlCqDuYxNgYxnt6EH6HNDeHtYUnekoKna2Y24+bBzx2JA/EV9MbVPUA/hR5anqq/iKAPnG10zUv7Hurd45FlZ0eIMhBY7iCMY65GPrVAaVq/BHmcgEfK390kdvY/iDX0Jr8axS6ZcBQPLvUUnHZs5/WtfyIxjEa8dPlH+e5/OtqmsIPy/UyhpKS/rY+YpLDVI88k4BORk8bQf5c057bWI2Yb243ZIY8Yxn+Y/nX0z9mhIx5MeP9wemP5cUptIGBDW8RB6goOeMfyAFY6Gx8z+VrKsVEpB3f8APQ9d2P50mdaDri4ckkYxKe5OP5EV9MNY2rZ3W0Jz1zGO5BP6gH8KadOssg/ZIMg5/wBUOu7d/Pn60AfMwvdZVU/fTEYBX94ehBI/SmG/1UZJnl+YHP7w8jbz39K+mf7I07j/AEG2+XGP3S8Yzj8tx/M1E2gaQRg6ZaEYx/qV6bdv/oPH0o0A+ajquqDd/pEuMEH94fQA/wBKeda1g71NzN8zEsPNPJ3Dn65A/Gvo5/DWiuCG0q0IOQf3I7gA/oAPwpreF9DfO7SbQ5JJ/dDuQT+oFFkB88J4j11RhL25AJzgSnk7v8c0q+JtdO3F5cYypH7w++P0zXuOu+HdDt7dPK0q0VnbkiIdM7v581ziaDpJlUDT7fjn7npn/Gp07DPMU8TayDu+0zk4xkSHkbef0A/Kp28aeIWDb7+4YkEtl+vyAH9MV6S3hrRlGP7PhHGOAR2x/Ksu40fRLi8NlBbQmbDFxuOVyBjP1ApadgORPjTxPKf+P24cqT/FnnKk/rg04+NfEyZBvLgA5ODjH38+n945+tbN1o9pGDst1Ukndj6jP6gVVEERbDLwDxz/ALW7+fNFo9g1KEPjHxAkgaKeQsOAdinHzkjt/eJP1NEPijXBIjK7ll2Afux/CW29v9pvzrp9As9HXUIU1CNjbsVUOJCpjYElT9Msc/n2ruR8PdACgLDOMAAHzzxhSo/mT9aFFdgPIk8V63Gqqp4UAD9yp4CFQOn90kfShfFWrqhRokdSuGDW4ORsC+n90AV62fh1oBBAS5UYI4mPHy7f5Cg/DvROcG6G7P8Ay29ce3tT5Y9hnlb+NdYbcJre3fO/dm1XncVLZ/FR+VDeOtULszWlqSWJObYf3w//AKEK9Tk+HWiynLPd9c/60eufT2qE/DHRN24S3mcg/wCsHrn0o5Y9gPM4/Ht7FJuGnWLYII3W2cYcsO/qxpn/AAnU2IwNKsAqbSP3B/hLY7/7Rr0v/hVujYGLm8yMc715xn296gb4TaSVwt9eDj/Z9MenrzRyR7Duzy+bxcrwlG0uzCkKBiM8YQqO/oa7j4Z/EnTfD+iyWusb4bd3LxNGhba2MEYHPOB+Nch4l8MS6TqE9lK6okbfLI4Pzpj7w+v881ztwqweXFH0VRz9eapJLYR03inxTY6jZRGyMjXKXHmBWTAxXU6f4+0aS1iN1PJFMqDzEeI8EDoMdq8yjZr28hgtrcNLHGThRksarEsykSDEiuVNJxTHzHoms+ILO+nmj0mQsXcHzh3Hpz3p0ev36eUguSVhGEDRocD8RXLaJbFYy7dWOfpWuqdTU2KNn/hLdYibMd3hR0XyY8fltrNv9V1u8WRh+8Mi4J8hBn9KqyAgHHNT6bqCvILWRvnwSnuB1FdOFpU6tTkm7HNiak6UOaCuQXGm3Ny0T4UN5Sh9x6NjmqV3ZtZsiyMrMwzhe1dPXNX8vn30jZ+UHaPoK9HHUKVKPMt2cOCrVKkuXoiqM0vPenYoFeOesdV8MRj4j6Z/21/9EvX0HXz98Mf+Si6Z/wBtf/RT19A1pHYiW4UUUVRJiagP9Ok/D+QqtirWof8AH9J+H8hVasnubLYTFGKXFHSgYlFLRQITFJS4pcUANoxS1HK2BtXhm6e1IQxh50v+wh/M1KBxTUQIuB0FKeKybuIOM1xnxB1dLe2SztJGW/Ebzoy/wAKQPxJP6V0OsXdxaadJcWgjZo/mYSA4x37ivOLtvtuoS3lx800v3j7en0r0cFhp1Jc62Rw4qvCmuR7nDw6vq8kqr55IJAwFFeg2l1DpFnbG6cLLPJs55LZ6Cst7W1gj8wQJmP5l471nCa41XUFiu43K20q+QVGAO+T6jj9RU4nDuhZSerNKFdVk3FbHR2fje2fY72rpCYZpHYHJHlngD3IrrbG8SS2jmUkRTIJME9ARkE/hXJx+FoDpbReexk8qSNXYDb85ySV9e30p2lSjS9ansZklZb6cRwMRhQqRDn6dBXGdJ1MuoQ3lun2ZtyGmbtqHHOKw9GU211PZvx5UjAfQnI/Q1uJyGWkI0dFBDMD/AHa0bu5js7Oa5nIWOFC7EnHAGaq6SgCyEdeBXNfEfVPJsIdKjbDXJEkuD/Ap4H4n+VaREzhri4m1fVmuZcb5mLFsY49/p/SsyfZDcSS2+QWcMAecc+9aS/6PYPKcAyHYv9f8PxrHbMkmBVkXJ9Nt1luQZP8AVpl3+g5NVra1u9e8TRGNJAhl3PIEyIx/KtQOmnaQ0k3LTHaEH8Sjt+Jx+VNsG02OPM14kcv3nKsRg/h0pMaMbxFbXWl+Irqa/guFhuZXMEu0AScevStT4awXV94+sruJJfs8JcvKU4xtIxnp1IrW/wCJJcIZXdLx1BwSSef6VVt7y+tYwlhc/ZYwcqkLbcVPQZ7limuwjRnbooLH8K57R/C+sajpdvdxeI3lWVAxKysceo6dqmvfBevraTGPXZX/AHbfLvPPHSle4yF9D8R3nhtdVTW5EuJ4POSBMKq7uVUce4FeQeIrm6vtcu5dSkEtzE/ksy4wSny8Y+hrYfxbrMmjrbMzxxCNArCT7oXGMflXP+X5sypJkuzZb3qokyI9m3YpYbUTkH1PNVLhRIvzNkEE9e+eTV9I3up5RGo2Zy7f3VHFU5x83lhQM9T2xVCMg2nJI5/Co2tcda0ZNx7cVCQx424pDKX2TNNNoO7AVbaNm9fypPszd8/TFFxFM22BwQaj8jBJAHNaIgx/CfxFAhxwKLgUIVlgmSaElHQ7lYdQRXfN4gW48KTXiELcKnlso/hc8A/TnNcg0QA6fpUZyibASFY5I7H/ADmumhiJUbpdTCrQjVs30M/7MTj/ABpRasV4zir3l+h49hQI/lODz6mua50FAwFeuaYLYsetXmKttH8XUjHSgR4OV9cn3ouBU+yMvU017dwcE8j1rR2MM7ckk+nSjyct8y/iaLgZXlkc08RlkfH93+tX5oF2gKKS2gzIRtzkEfpTuIzUQ5wcgeuK63S1MelQnnLZOfxNYqW/7wblB55xW9b7kt4Y49p+UfJnrSkxo7XQ/i1b+H9Lt9Ik0h5xajY06XAAbknIGPevY4JVmgjlT7sih1+hGa+VjqaWetGcpG0kU27a43KSp7+o4r0qz+MN9a28FodNtP3Uax7mZh0GOahDPY80ZryYfGW9Miqul2jszbRtkbk1Ovxa1LcAdEgJPpI1PYD1OjNeUj4zvuZW0qHcpwQJjx+lTRfGN5X2R6QjNjgCY8/pQB6hmjNebD4sz/xaER3/ANd/9aol+NFuR/yC1/Cf/wCtQB6dS15rH8YIZSRHpDPjk7Zv/rVN/wALaiVSz6NKqgZJMwwB+VAHWeKVJ8PzunLRMkg/BhWujB41YdGGRXml18U7HUrOaz/s90M6FA3nA7SeAelWYPihbWsaWj6ZPLJbqsbssg5IHXpWz1oryf52/wAjJaVX5o9EorgD8WLIAl9KuVHu60o+LOm7Qx064A/31rE1O+ozXCp8VdMkxs0+7bPTaVNIPizopHNrdAf8B/xoGd3SVxUfxT0WU4jt7pj6AKf61MvxI0ljxa3n/fA/xoA6+iuS/wCFj6OBzBeD/tmP8aF+JGiseI7sH/rkP8aVwLviR8yIv91Mn8TXG+INYj8PaadQkjaXDBVjDYyx96sa54206eZpUjuggAyWixgfnWFqslr4r0t9NhaSN2IdZGjyqkevP4VPUozW+JFxJZm4Nraqcn9zuYntj5s/0qha+I4rbU/7biRZJLxWRrck5jII/i6EcGq9x8O9dhsCtvdxzQhtxiClf5iqg8OzRCNYFbKDLF8AE57VehOp1UOtLqsjNIixsw6KeppqXcNjdyG809ruF4yqlGIMZ7Hjv+lZVhaPayqbpiq5/hwa02O/cBztOMkdRUsaLWqXmnSaw8Wl27wQhQHjZi21sc8/Wu+8Ga99utBp902biBfkYn/WJ/iK8sYsje1XtP1GawvIrm3bbLEwZT/Q+x6UIZ7dS1S0nU4NY02K8tuFcYZe6N3U1eqgEFFLiigBMUUtFMZieJ/DsHiLSWgkVPPT5oXYdD6H2NeK6hpaRXDRXFtskhbY8Z42kdq+hK4zx14Y+32zanYx5uol/eoB/rUHf6j+VIDyi1RNOvo7yx/dXEZyjrwRVS5j8+5aef5pHbJPqatS/d4piIJZFHcnilcZp2EPl2gzgbqshM96VItiqo7U9h7VIypOpA4rDikJ1SSWMkGLCqfQ9TW1fSiG3d2PCjNYulQeRaszjc0pLkntmmnbUHrodN9uD6a868MBgj0asML60/JCkDODyRQBkV04jEyr8vN0RzUMPGje3UZik25qTbRjNcx0nUfDMY+Immf9tf8A0U9e/wBeBfDQY+Iemf8AbX/0U9e+1pHYzluFFFFWSYeoti/k/D+QqtuqfUv+QhJ+H8hVasnubLYfupM03NFIY7dRmkopiFzRmm0UAOLhVJPQVGnJLN1P6U1jvfH8K9fc1Jj04rOTELnNMYmnGmMeKkRynjq+8jS47RCQ1y3zY/ur/wDXxXG28hePDjDD9a7698NXfiO8muINojhPkR7jjOOWP5sR+FYWueE7jw1o0l9dGMgMEUKckkn/AOtXfhK7oT5uj3OTE0VWhbr0OO8QyuunMkT7CeS2ccelW9BsGbDOTuJBc56nFZd0xudcjfzAYhH/AKs9T74rqNKUDCDgDmli63tarktisLS9nSUXubygpHz0rL1lJYbT+0Lck3FkrGFSAQWbC5OfTrWsDiAZwcdTSTJFPH5MqLJGw+ZW5BrkOkoODHr0M7cfaIFZh/tDr/StqAbmbiubs5Li50vTru7k8yYyyKXHcEnH8sV0+ngne7dM8UEmpp7LG0gYhVVcknsPWvKNY1Jtc8QXF6c7ZH2xLjog4X/H8a67xVqrWOlyW0DETXmYwR1CfxH+n41xC2waznkZmjCqFQr13Hp/U1rFEtmrrHhzULe0eST7OqW6oNnnqWbcM5AFctBEzXIjA+YtjHvUj7lhMTSMxKBWJJ7HINXdOiEay3LcmNcLnux4H+P4U9epJHPZSarrcVjb/chUgE9ML1P4k06TwTcksWYED9avaK0UeoTSXEbuqhU+Rtp9Tz+NbGpXunm3C2S3cdwCMq8m5SDUOTHYzNJ8G3bh4H1K3tIlGQJ2ABOe1Oi8Ls2rRwHVrHbkAsHGAM49K5vXdTlW/Ee9vlQZyfX/ACKxzqbxTEnqR61LUn1Ge5Wngy9sFK2Xii0gXuI5Aook8L6luyfF1mCeu6cc/pXi48QykcufxapI9XL9XX8SaaiFzrfFHhSLw3aW7RanaXjTuUEcEm7aAMkn26VhCK3jiac3SNKq4WFVbI5wecY/XvXZ+EvAtz4m0EalHJbBWkZU8wseB1/WtlvhLqBXAnswO43v/hVq4rHmcPid/D9uQtjZ3azDYY50OMDvkEHPvWZL4sjmLtJoliQeihpBj/x6tH4j+HpfDetRWMzRsfIWXMZJHJI7/SuJdjziiwjXbxZCnB0OzJBPO+Tn/wAepg8ZW6j5tBs2OMZ3t/jXPS/e6VXc+1UooLnT/wDCa2wPzeH7UgNnAkYfhT18b2Wfm8PWxHUjzmB//VXI44phGPxo5UB2SeNNMy3neHIWBzylww5xx1z3qF/FmlFV2aCqsc783J2k54wMdMetckVYdqMH0o5UB08niXSnRQdJlQ5+bZdcH8NtIfEGjEHbptwgJ/5+Qcf+O1zDD2qMjI4o5UFzrP7f0Q4xYXI9zcDn/wAdqUaz4fZfmtbwN6JKuPzK1x+KUZH0o5UB1UmpaHuUol6Bj5gXTk/gKUarow/hvM56/Ka5bml5o5UFzpxq+lZ+U3QHf5VP9aT+0NJkH+suQR2KD/GuZzTl4o5UFzpjeaY3SWcr7xgf1rU0exS8u4BFMkMcjqBLMdqqCcZY9gK4xWP516L4U0C71Tw3E8VpLcRszAhACOGqZKy0An8Q6PLYpD5l7aXfmoWzakNtwxXB4HpWRGiiRFbjJHSuth8DancnMWnXTbV2jA6AnP8AOsjVNKl0bVktbq3aGQIr7Zh82Oef0rPUaOSivxb6v589pHcRJOXMbKRvGemRzTprwXM5m/v9RjBzWOZndslycn1q1E4aLAXBBq46AzQhlWGRZN3zBgw/DmtmPxNPGQyTcg9Nlc2zg4K8inBsjrRLUEamo3gvbpZgip8gHyjG4880ljI9pcx3CyKpRuByeKos2YlA6gnoKYsp7k8VXQOp1C+J2U/vHRx3BXr7VgyBFnbymzGTlfpVUtmnK26IHsDg1K0Bmpp159iuFlEmPlIZeufwrVl8QxSwyRPgpKhVgF9ayZbOAWEcnnfvcEMpzgdwPyrOBIPII/Ck9WMsF/Im2g7uQVYfpXQXOorp+vyzcbJ4lYggnsP/AK9c+bK8n2Nb200mR1WMn+Vbeo6Nf38Vk8Vt862ypJvYLgj15rrhTnOlJJPp/X4nNKcI1E2+5Jda7aXFu0ZVQW/iVSdtY0lw7/K7ZA6YHFMv9LuNLWMXflgyZICNkjFQGQCNSTnsQa5+VwfLLRm6kpq8TodC19tHkk3LGxyHUsuSrCs7VLqK71Se4tVWKKZzIsY6Jk52/hWaW3tlTkEZoD80utyi1bXjWd8kynG088du9dpa+aDFI65DAOpdeHH9RXByoSEcdD3qyTcSWsLl3YL8q4bO3HQe1DVyTs316CSQxraWqbSVbDDP6mtzRPEnh3S282fQ1uZuu9plYf8AfJ4ryxPEclu5ia2spNhILSwKWPPc1MPFGfvaZppH/XAD/Pf86ycWWe1SeOfDt5aTxN4egUSgqPlGTkY7A461S0DWNA0nQIotRjAmVUjMgQk54A6D1PWvJl8TwFSraLYE+oDr/Jqcmv2IjcNo0RZlIGJnGOvbP0/Kp5O5Vz2G68S2Ucx+zBdp4GD0rldSvmmug1kVSN/vKQOD6iuNg1u2KgrZGMnqBISP1q7DrMXnArEQM8854pqNgudCul294mZZ2I/iGcYqnHbNYXjwSElOqEtnK/4iraojLu/efN0x3qjdpCFJ+845IPBGOtUhF2a2G3cOQagEew5qxYzLNAIjgso496kt7uytbiePU7KeZWiJieEn5W9TQM2/COtf2RflJWxa3BAkz/Cezf4+1enAg9K8g1mbSoNZFtpHnBNg3pMQSrY56V2/g3WvtVr/AGfcvmaFcxEnl09PqP5U0B1FFFFUAUlLRQMKQ80U13EcbOxwqgk0hnjHjzTLey8RTvYjbExBdF6I5GTj2rD0yEteDI4Xk10erzfbr64lf5hKxJH1rPtbWG353sXJOcqMY7VLAsiPLZz2oaLA4HP86lQKej/mtRXE8Vs22QnOMj5Tg1JRha82Yo4B1kcA/TvTEUBQOgHAqS8xdaikygiNVwM+tPKDHFUBGOaXHHSnhKCtAiL2xS7ScYp+3mnhaAOl+Go/4uFpv/bX/wBFPXvVeE/DhcfEDTcf9Nf/AEU9e7VpDYzluFFFFWSYGpf8hGX8P5CqtWdT/wCQjL+H8hVWsnubrYcKM0maSkA76UtMzS5oEOpkr7RhfvHgUpYKpJ6DrTYvmzI3U/oKTdgFRcL6U6gnBpCeazEIxPaoXbYpd+FUZNSO4UH+dZ2oyNJZPEjcy4iB92IX+tNCOr8PwtDoNoJBh5E81/qx3H+dcX8X7zZpljZ5wJJC7c+nT+teiRqqIqL0UACvEPjZf+Z4htrUMQIIckAdz/8Arrd7EdTjLIzbpftA+ZXIHTp6V0+nTkNgZ6Yx6muGt5XgUSRyKB128jNacXiF4FDQlC/pg8H1rOxVz0V5GiiRXUhG4z70+IEhWIx1x715tceI757A2dvdhS7ZeXByv/1vpVSV7rT5Y5f7WnvZiqsrDzAqZ7ZfGSPYUWC53F3qU1vpOpXE67ktb1VhRQBgYAx+ZzXTaI0zaHbPdACeSPcwx0zzXHv4gtr3R3W8RWjkZC0aLtJcHJz9cV0H9sxajokkWksxufK2hAhJTtnj0qrEnM6xf/b9YnmU7oov3UX0HU/ic1V1V/IgitANpQb5T/tkf0GB+dXY9A1CDYVyCDlQ1uxBwaWbw1qN45eVWLMSSRbtz71qrIizOciBcknkk8e1dVpOkvPaJlRtj+dsjqx6fp/Oqi+Fr2JvlSTI/wCmDV1MV4mjQ6fp9yu+4u43mkccY2jPT9PwqJy0GkM8LeFbzWtPupI/KSL7QxBcYLHJ6HHTGK1j8N7094P++z/hXR/D5QvhZCOpck5HfArqKUVdDPHbnSorKd7SWKNmifaTtByRRHYWbY/0aBmXqNikj61PrV0kV5dXUh+RWeQn2GTXnPgnV55vGUrXDk/bwxcE/wAX3h/LFQUex6Pp1i1q26ytyc94V9PpWiNMsM/8eVt/35X/AArN8LyTSaaWuc+YXY8jtvbH6YrcXrVIk2NMgjt7BEhjSNck7UUAfpVuobQYtI/pU1aLYD56+M8S3PjyYFiNlvEvTPbP9a89GlwFBvklLE4wqiu7+Ll2E+IV/kE7FiH/AI4tcB/b8IkZ2gm3A5AQjFLW4ic+HYGx+8kz/uipE8J2sqEu8h46gDioj4tiPH2KbA/2x/hTk8aWyxnbaXGByRuWgRHN4TtYycTSgjnO0H+tVn8PWZXBmmBx2jH/AMVVyfxfayrkWVwNw9VqofElrIeLW5/8dpXGPi8KWzAH7TMB/wBcxyP++qc3hK3Ck+fMTngmMf40R+MdOjAQwXYI4wFU/wBasN4vsRGMw3Z4z9xf8adwsZj+HrFGx9rnJ7jyBwf++6mt/C1lLHu+03BOf+eQH9arnX7Rn3GO45P/ADzH+NX7XxfpUEYWUXIbPaIf40rhYrv4Us9523UwA9Ygf61Wk8O26cC9Oe2YTWwfFekSqSguCD/0x/8Ar1lz+INPadiHlxnoY/8A69GoEcfhmKQ5F6Mf9c24qUeGImU4uhnHBw3+FS23iLS4h++lkXPI/dE1aTxHozKf9MK+xhbn9Kd2BlP4dRWI+1x5Hqrc/pTF8Ou0gVJ42z3Gf6irs+uaY0uUuCR6+W3+FFprmnrLve6Cj/cb/Ci7AZH4WuOpliA98/4V7r8MbP8AszwlFbiRZmVpSxAwASx459q8i/4SXSiuFvV9/kbr+VetfDi/ju9A3QuJEJcBxnHU0EvY9B0g/u2KseR/WvGvjBfwW/jGN7jKsbNAMISW5f8AqK9e0mTPC5I2envXhfxvZrnxxtVcCK2iUfmx/rUSHE8xjj3VcWI+QSP4Tk0+O0aNfmGD7mplTCuD3XjmhFESbnOSB07KBU4izz/hSWoz1GcCrSttJAbAU47cU5CRX8giFuPfPNQImXHpnFaIZCxVsneCOtQQRGO9UyITGDlvp3oWwDRAuPmD/gKdHCp3CMsTjJBFS+ZknHIPTApUfZKp25wcnipuMuC5iawFu9lNv6+cM7CRn268jvVFI41zncfTk11vh7VbyRP7G8pZbNgxY45UY656YzXNTweRM8Rz8jFQR35pdQOg8Manvj+wzNlkH7ok9V9Pw/z0roa8+tjJFcK8LlWU5GAM12Samj6S910ZFwy+jV7+BxSlDkm9V+R42Mw7U+aPX8zkvElx9r1iTBykX7sfh1/XNZqxboymD6jipJGZZXDnLbuTmlSTa2QM49s5rxKlRzm5vqetCChBRXQrrGwVhjlOad5fGScjoa1rWFJOqgBhVOVPss7xMB8rcHHUVLZZFEu+Nkz1GRz3qWxXN0iNL5CSMEaXGdgJ+9jvjrSR7usSjPY4qSbKzbyBtcZOOx700xH0ba+FtDt7OCFNNtJVjjVRI0KktgDknHOcA1S1bwn4dXT3J0SxycAEQjjt/IVV+Guv/wBs+E44ZGzcWJED+pXHyH8uPwrW8RT+XaxLn7z5/If/AF6TLRxU3hXQiwA0q1AOc4T6/wCNZ83hHQ5cg6fEvPVMr/KtfUNTi021W5nDFWkSIAerNj+tQa1qkGiabNe3WWVeEQdXY9AKgehmp4O0iPGLTAx/eNTDwppi/cgA9MnpWH4c8ftqmqfYdThjg804hdCcZ/unPr613EXPftzmlqh6HOzWxtHEUUTlFGQd3FVpLZZ7yEzRMWYhcl+1em+F9K07VUuY7+3WV4mDKckcEf8A1q0r7wvpFpeWEsFqFY3aAgsTkYPrVpPck8ci0x7S4K7WDIxXOfT/AOtU08iliHXaQcEH1r2yfw5plzdyvLbLuchzjjtj+grk/Hvg6CLTRqmlw7WgGLhB/En976j+X0osB5y2xpDIcGRvvMep/GrdjdPa3STwPtljbcjZ/SstlK+uRTFdwwwTjtVWC57bpOpRatp0d1Dxu4df7jDqKu15Z4W186RqI88n7LMQsw/u+jfh/KvUgQVBU5B5BHegYUUtJQMKyfEt19k0G4YdZB5Y/H/62a1TXHeOb0Yhs1PIBdh9elJjOGkOeajp0h2RknsKj3ZAI6YqAHiTbSzrHdQ7ZDyvKnPSq7Md2KmiTPBpDMxl8uTY35+tOx7VcngCJl8E5wtVwtMBoGKTHOKkAoCc0wI9uKcq+1O21IFx9aAOi+HS48facf8Arr/6Kevc68f+GWl+f4lW/YkJahguO7MpH8ia9grSGxnLcKKKKsk5/Ux/xMpfw/kKq1e1H/j/AJPw/kKq4FZPc3WxFRmpMAmjaKQEeaWl21HKSigL948CgBD+9fb/AAqefc1MAB0pkaCNQBTx0rJu4gxxTGPFOY4HNVp51jjJPFAiG4l255rHu9QS1urKSVjsF0jNz125b+lWJZjKzdcVy3i+58i3tgOfnY/pj+tWhHoA8eWcQ+fJOeMGvKvGF3/bfim9voQoy4iidwCBjgDHesk6hKJF+bHNS3MwuNEsIfO+dr/zWVB90ZOCf5022KxBJo4KgeQ+7v8AWqo0iUXJVLdjtXJGPWvTrbUtM+2Za4iXnuwqfS9X0uXVNQuGuIlLz7EG7qFXGay9o+w7HBaP4LudXuP+POQbByUOCB3rrLrwBCio8WlzZjVU3OwJbHqFAzn3z0r0zSLjTorINDdwnfySHFXjf2g4+1Qj1y4rWOquQzwbxbALH7PpvlCKVm8+RduNi4wij8Mn8q7T4Q2Y87ULsjBVEiHHqST/ACFcV8R9U+2+Ob94CrrAViBHI+VQD+ua9I+EEL/8Ia91IuDcXLEe6qAv8wa2SEd5RRRTAjnlEFvJK3SNCx/AZr54n8SLdXbXd2ha5iR4YmDf38jp/wAC/SvdfFV19i8J6nP/AHbZwPqRgfzr5cuHkS7WVOWDgj86TVwN+D4j6/p8hisbt4oA2Qn+elex+B/HY8S6Fc/aSov7WLewHHmDBIIH4c14LdX9uIZVWKSJpCS0ZiXHJyfm9PSotI1a8sLv7RayNGcg4Xpx0pbLQDvJ7XxDr2nXAGlyeTcAr5kSMceuODWbpfgPWNL1KC+isLxpIW3BWRsHt/dq5Z/FDxBb2Udvby7UjGFIhB/XFWx8WPEYXmZDx3th/hULYZtwat4lswQvh933kAZV8D9Ktp4i8SrjzPDje+A/+Fcs3xV8RtICbpQBzgW45/Sp4/iv4i3DdLGR72/X9KAPZ9Mkkl0u2knj8qR4lZk/ukjpVqq9hK8+nW0s3+skiVmwO5AJqxWi2EfMXxRfz/iBrBPQTBfyVR/SuDazklkCwRNIzHACjNd18Q7qE+N9TYuozfOpP04/pWJY+Jv7A1KC5shDMU5AkXcAf8alt9BFDSfCOoXWs21vf281rbyPiSZ0ICjHvWraaDY2WrSQ24gvFSfaju+1nHTjnGPrXQH4qXuvSCz1Q28Ns53M+0DGORzVW68S6NBOo+0JJJjOYkLAD1JqLvqA7X/D+k/Z4orO0WG5nBbapUngHjIGOuOa5VPCt7bal51x5aRbj8hPUY7DHWtyTxMsWoW11DMs32eRXVM5FWdS1+0naRgojlfOZFPSpu72GcZNoFoCWMnVj3qBtLhEZKsxwM4z1rtbrXdHgiDfaYWYnaMJuLfkKrXesWDabLJa3NuxMZIXADE+mOtXcRxsul6qsh8uzkVD0yvQVNLpVrNa2+6Bo7nbmZs/eJ6DHau4X4tzLbqn2G1yAAfk9qqtrVlf28t/dSW0EkhLlSAPwA60k31GclDo0cfzJvxnlSeDWNNYXjTOY4GKbiAQPevQodT0yaDzBcQk5xjABH4YqbTfiWmn6Wlm2m2cvkllDvGCW+Yn+tVcR5/BpQmtwZ0dJAcEVdbw2iEDD5xng16Lb+Mota05hLb6fZ+S+5GECBg2Ou7riqcfiGzkuFeKSznmGTjaHB+oIOaOYDy++0+aG5aOCNmRQOevbNW9M02KW1uDfrMsioPI2jgtnv7Yr0G68eQJql39t0uwkdjGR5cQRR8gGMDgVZs/Edjq+1H0zTYVi5PmRBjzjHWjmYHnY0XapIDZxmvb/hVGYfCAQPgb5MD15rkL7VNL+a0QaUhjBxsgTcc+px1rtvh8UbQV8tgFG4fIMDPpVXuSz0DSC6qASBkYH514x8XEkbx25PP+jx8/nXrmmnc6csPl/LmvIfipfRw+O3DOh3QIcOAc9amQROI1oXFxYhPM3AsMk4J6Gsrw+GtNTWS6iZkVhuRgfnGeRXV22rW0F6txe2cMkP3GjRAgOR14q+/iXw+9woXSFPykAFj949Km5ZianLZ3OoSTaXa/ZICBiLPT1qnJK3lMvLblORn7xrQdbdOXjiQZ7nA/nQgtrd47lrdGSNg5wTyB+PpVXEc7bPJBcBhEV299vStmKZjcgsSwJ5ya6K78Q+G2gx/ZY+YjkMRx3rLKWYuTOlq3lt86KztgDtSTArKrTRSQYjBZT8xUZ/A1lx2OJP8Aj44TBcGQ/lXQSfZZJN32bZk8AOcVovqnhCO2+SwfzduGO7+L/wDXSbsMwobuWJkkid42K444yOlWTcmU5lWIkjBYoC2OnWrbXOn3e1be2f7OW/dhpG+XJwTgVDJDAJCFhKD/AGXPP507pgVorRo5nlj3B41ywJOD/StA2xm0We6W7iUhwkkGcFsdCPWrNtf+Eo7VE1G3ma5UYk2PgMfeqbHSriMvaRybRwF3YwcVKbT0Bq5ksmWyybs859a5q+uLqK8kjV3jUNxtJ6dq7ZLaEAAiT65z/SrtivhpVddXSUTbhs2jPy47/jVcyQGRoc1vN4bkF3LJHfW7fuTnPmA84I/PmtKLVoXjgS+tEmQA85wfcZFNni0NvP8A7N87g5XJAHXFVAseza6tjswOKWjQFPXLaTS/FUvlF3sZEWaJQ5K7GA4+o5resrCyvcW9xO0GBlJETfn0HJ96qW0WmYddRkdVwPLIPIPfH4U4SwW7bYFd0wNpY44x6UAbmia6/gXxPcrbTJf2rEwMxGzdg5DEeoNdndeKbvV4UlOmM8agkGDcf1xivKnSCVtzBwcdiK7yy1Gb+zrV7e4niKwIoK8dBjjH0oDY5nxt4juvtEVpGrwIAshhkA+YHDI+QTn+lcve+IdR1KJY7+4edFOVVznB9RXU6rbaTfaxNJq/iMpOpIMb2rOYxknaD+J/Ompo3hVuT4ph9s2L8/55/MVKaW49zgBM0U24khlOVYHoe1dzYeNb91SR5iwI54FWH8O+FpFc/wDCTWbED5c2bjJ9P0/Ue9NbQdBt4cQeJbJ8ZwotnAPX274/Ue9VzxY7M9H+GfiqG51ydLmQRhrZmZnOAMEf41kfE34kTXOoy2miXDR22n7SJImKtNI3GcjkKPbrXOWFvZaI9xcWutW14vkunlxq6k5U4xn3ANcTLfyJqU7Pht5IZWHDA1S1Qmdr4X+Kfii01WNZZzeI4YeVOxKtxngnODxVnT/iH4l07Q5bC5kdllk8wPMNzEOMkZP8J5P41xn9otC0MsEMm2GNkiaTB2lhgnIAz7Zqe31CRpIhLudVRUGW5GOhHpVWEe06X8PH1PSrW+S9t9lzEsoXYeAQDiro+F8nObuA+nytWv8ADHUDf+BbXcctAzQnI9Dkfoa66nYDzl/hhMV+S6g3e4aug03SbrR9LitbyZJimVRkzwvYc101Vr5N1vn+6c0WGmZVJSmkqCwzXmHiS8S71q5ljztD7OfVflP6ivSLyf7NZzTf3EJFeQai8iOTEm87skZ9TyamQyGUZRge9VgTsWrTKStQYJbnt6VAxduSCKtQpUca561YQFVOADgEgZxmkBSvXD3IUdEHP1NQYpIS0imR+GkO4+1VbvUBCxjiG5h1J6CqQFzbzxS7cVhS31wx/wBawB7A4qNbuZeUlcY96qwrnRKtKFqpp999qXy5MCQDPHcVs6bZG91G3tl5MsgU/Tv+lIZ6d4BsPsOmWmRh5t0rfiOP0xXbVh6YipeQogwqggD0GK3K0jsRLcKKKKsgwtR/5CEn4fyFVqsal/yEJPw/kKq5rJ7m62HUlFJSGBYKCSeAKijBdjK/U/dHoKH/AHsmz+FeW9z6VLiokxCc0pOBz1pQMU12qBEbHGcmsu+l3NitCaTCVlTEFiaaEQY9OSa47x42w2aeqsf1FdoCMcVxPjoeZqNqo7Qk/wDjxq0BxwZg3X86pfbJEb9y25FbBcA4xWjMnl28jeik1zazOA6DO1j0B4q0iWa39otuGW7+tLFfmPLCTBLE9axSxqTnAzmnZEnZWWvTxRKElP8A31WhBq80rZZyRnnBNcTbSCMZ6+xrYtNTdHVhFHnGANnv3q4xQmNlvCZrzIyZn6ntzX0d4EszYeBNJhZdrG3EjD3b5v6184Wlubm8MTKS0j7VAHcn/wCvX1VbQi2tIoF+7EioPoBiqYiWiiikM5T4kXIg8FXCH/ls6R/rn+leAXcQGG/2hXs3xgvBDo9jB3klZ/yGP/Zq8UuLjccdhSAn8sTLhwDUMx+yRtIgHyjgEcVEl95Z5FR3t2k1nIgPzEdPxqLMYz/hLbu2iCJFCQOmVpE8Y3rf8soAP9ysC6G3FMj2ke9Vyom516+I5JEVnMWQQcCMc+1Wo/E7J1hhJ7ZWuQSQBcKxqeOIno2R9anlQz3mH4wxxxxx/wBnoAqgZEh9PpTn+Msa8rp6sP8Arrj+leG7rvuOPwoLXBUA4/TmqsBN4hlm1nWr29EIzcXLyhd3C7mJ6/jWVH4d1G5iIhVfM3fL84wauS3zQPsCBj3ya6LQfGf9mQeT/ZlrMc7g0xJx+VK4mctF4W1jfsnKBcdN3etey8LwtZzLqVo8lyqERSRyALnsCK6KTx+7vubR9OBxgYD/AONRf8JshICaTaIuPmId+TSeoK5x03hTVY9zJGgB4AEg4qC28P6u90Bc7RBzuYSjNdhP4tWWMK1jCAO6uwJqofE8KfMluQ4PAWVh196A1MrTfCStdrHrUMj24YENA43jkZ4z6Z71WbwleveLFbwrFb7jhpJlU47kknjit9/FETuCYO33vMP+FMPiCCQYaBiO/wC9P+FIDhpvD2rLfSrBEBHvOzMqt8ueOe9a9l4XunmRbyF3tmwHMbrux6jmt3+1dOBAEE+cEt+9HX2+WrUWv2cYUGCTAHGJP/rU2Bh3/g64W6f+yIZZIQqkyTSKG6DPU+uawm8Na80kr29qhVCc75Y1/IFsn8K7uTxBaFD+7lB/3x/hVKXVbF3JKzjnOMr/AIUkBzVp4f1RlXzrdiDkMqkcdsda6G38LWmn3cMlo11I4T5y8fyp9P5Vbttb0+ADb9oJzyCF4/GrP/CT2Y52TZz6D/GkwOD1fRdUXVpprW1klTIIDLy3vipbHSdUnsJpLiGRZzNu2Mhy/H6dTXXza5ZuxZPtAJ/2V4/Wo7fW7GLPzXBJPdF/xqgM/wD4QiAaWt0tzJ9r80lrcqSFXHXOOTXYeFdZXw7pYtpoJJG3MTzt6n0rOk8R6cYgP9KzjOQij+tcfrt8LrVjLbySiPy1AEg59+lA0rnsVt4+hgbItJTxj7w9a4Tx9bw+KNXj1GGZkfy1iMTnjA5Bz+J/KuIWeRWO1yeK1La7mi0ovuOVZiKTTHypFq/0S+k0lv7P8uSSEb2BblgByB789Kx9NsNYubyHzrV403AklcHGRn+dRjU7tIykc8ixnsGq9pF7dy6xZo1xLtkmRSNxORuHFIR1Mngq41e8iQ3sdnHGuC7sApyQO/1/IVlXWk3Gm+G7tQ3mtAh8sZzu55OfzNegajDtsZD0wueledXfiS/MkkexjHnAVlBXH5VN2M5WG9uppVSSPAP8WK7+bwzc6jY2aLdLbDaGG8AhhtHHNcxFqUMNx5qwqkhOeFHBzXodncTXlvaCU+YzKMgetNsDn4fD1zpNrNDcSLKIHZldTnIHJxjtxXCR6teSMqi0V2Jxjb/9aus8Rare2mv3ltFIzRo2Bk9sdMVjR6rNFOJVEayL0IjFNCOlsdDvLvwvC0GIppEyT/dO7mrWkeHLvR9Tc3c0UyOqsDGw2hhxgY/H9K6TRopZvC9rMzBZGjEjccEnn+tYmr6vNDKkdqRgjLEAYPt0qRnD61eXS69dxRWZmBlYhhFnIz1zXQaLp9y+gXB2mGaViUJTGBtHr05qpNqk0V0zbBvY5JVc12PhqSe78L3c82WIlVQOM88U+gGDZeF7/Sp0up7mKZJ0IdIzwDnuPy/OsnWLqOPVJLdIlaTCqWIzzjoOfet/xNdtplvbb5sNIWJUEgjGOeO3Nc6datnlWRraF3U/fKkEn1PrSAv6PYPMZOArOuCg/hwe9Sp4X1kXCai/lmCKYHYpwzLnoR6cY/GtLwrcLeXUuxI8FclgpHJPfNX/ABTM+n6XFLGxG+QqcfTNMDjPEYe31CG1hj3MyNIR/cGcf0rcXSblrVGVckIPrWH/AGsvniaSMSShdoZ1JIHp1rqfC91c6vqU77gFjiBKDoOQBRcDONhdDIZCMckmuhsjJaabDGZVYogzuB47461q61avFpFyY2Csy7FZh0JIAP61zM8d1JbnOoyBhxvESZH6UuYdijruhPBZy+IdQe3eKa4CFQp3gspI4+ikfgKxEez4VrNT/tAnn/P+FL4iudQGlm3n1Se6gaRXMTjA3DIB/DJ/OqkUm5FPtTQFqS5s4lYmwQ45++f8/wD6qba3tld79lkBtHeQ1XnHmRsP9k1Dp9nc2sSTzxlYrlN8TdiMn/P41ai2rivZ2Nu0Tfch0hEa54G/OBirv2KK4kB8uMt0zxWZDMVkG04rVtXUMMtSKJbmzjNqVKZII6dqghtFEg+UGrkzL5TgHtUELru5NUI9e+D12RDqFix4+WVBnp2P9K9Orwv4Y34tPGlujOQlwjRYz1JGR+or3SqJCmyLvjZfUU6imBhMMGmmprldlw6++agNQzQxfE9x5WleWOsrYP0HP+FedzruYsPWus8X3v8Apq269Y05+prkJVODz1rNjImHymoUGTSncB35p0Y4qGMljXmlvG8uzYjgngfjUkS1Wv2zNHGOijcf5ChAUZD5MY7ADJ+grFkXdB5j/wCsdiR7itfVQy2XyrksQpPoDWVPjzFQdEWtIiZUYE0wK2enFXYow7BT95quJpzM2SPxqiSrp0EpvIWTswJ+nevTfA9j5upS3jD5YEwv+8f/AK2a5GytVg57kV6f4VshZ6DGcYacmQ/j0/Sp6lo6TT/+P+P8f5GtusTTv+P6P8f5GtutI7ET3CiiiqIMLUv+QhJ+H8hVTFW9S/5CEn4fyFVaye5uthtRySFQFX77cD/GqOva1DoWn+fIvmSudsUWcbj3/AVyf/CwJ/ML/YY844/eHipA72NAiYFOzXAH4hXfT7HF/wB9Gk/4WFd/8+kP/fZqOViPQaa44rzyX4jXcMZdrSI46AMck+lZj/FDVy5zp8AGeBlv8aOVgejXL8YrPkrhj8Sb9xl9PjGe4Y1E3j+5PWxA/HNFhHdZ7Vzuu2Ud9rUaychbbPXH8RrGTx/MRmSzI9Mc/wBawfEniabUGiuU8yDYPL+U4z3rSGkrsmV7aG5q+iww6NeSqCCkLMPmz0H0rho4FKLvjYuwyjA8D60yTWp5Y2je5mZXUgqWODVaOeZlG2ThR647VrNpvRERutzTWzcox2JgcdOlS6dasVnQxxsUYHLKDgHNZkd5cBSok4NSC6niV23E7wAce3Ss9RnTW1gQvEcXB7gVr22nmSFkPkouME8cVxdvLdSRhjOVB6A9TVr7RcQozGfOBke9VZgdb4a0V1+I2nWcmGVbhHyO6qN39K+hq8Q+EMDX3i77TMSxtbVnGexOB/7Ma9vqxBRRRQB478ZrrdrFnbg/6u33EehZj/hXlMrHbXf/ABNvIrrxneBiSItsYwfQc/rmuHl+z7flV+vOTQIz2BPOR9KYIGkbbuAz3q2zWoP3HH/AqtLJpJs38uO6+1kjYxlUoOecjGeme9S2M5/UbEwQqzPuBbH6VStbZp5xGjYJ7mtrUmEti5X/AJZvj8jg1T0pDueXHAGBSvoIQ6TKrKDIuT6dqt2+g3ErqizrliAOvU1JO7/aCygnA6Cr1lNIsyMDtIYEH8am5R6mPgxeeUo+32pbHIKNx+lM/wCFK3ZY5vbRfThjn9K6nTbXxPqemw3g8SRILhdyL5Qzipb+w8Uadp9xdSeI4vKt4nlYmIZwBn09qYHzZqNo8eqXUa7X8qVkJBA6H3ptujxkmWPAYfKdwrLnLz3EkrsSzuWYn3NM+ytJyvOOtMRtv874Az7BhTZQE+6rZ46kVkf2dKzDCtyOOKd/ZVwd37o4QZJx0pAX3EhUHYcE9c1CyydRE9U30+UYVY2Zj6DpS/2TdFAzQuo9xQBbSOZ3CrDISxwAFp0iSo2Qjt77az/7JuhnKE89cUn9l3J/5ZmlcC24nVyGhkUjsVOadic5/dyYz3U1RGlz9lb8qeNGu2A2o3PSi4Fr9/z+7kOOvymmETHOIpCB1IU1GdBvsZKkU3+xbxOu7p2JpaDLGy4Rdxt5gOmShxSB3PWN/pg1B/ZV9twTIAf9o80h0i/HTeM991GgE3nMDwjflS+cQMhGz34qqbK+Vereo+amrBfSYXfIHPIBY5piNFLjchDAj0Fdf4b8DXniPSYr21sVmDMyFjJt6H61wR02/wAFiW475NetfDK81+PwrFb6ZPGqLLKD5mCck5PX60BdojT4R6q7AJpS47sJx/jXJeL9BuPDbTafeQ+RMqo3lhtwAb3r2m3n8aAjypLdsHuFryr4rXF9PrU76vtNy8UYOwcYGcUgu2ebhhu4BFbfh3DeItOCt/y3Xj8axBs4EZJ454rc8J/N4pscgH97n36GmB6trEm3TZQAThTXkU904kJSSZfTIGK9a1qXbYXCDj9ycN159K8bkZd7H94BnvUrcYplaacM0oLMRksK9Nsh5Mtuqc7WUYz715nYr5t9CgKkeYM5HvXpiHyrxN3OHXp9aGB59r7+f4iv5AnBuH+bP+0RWdnbnDY/DNSXLGW7mkKZLyM2c9cnNJGu51QMQWOMEdzT6Ae36dbtF4atY0bBW3QHI6nbXmWt3v2bU5UkHzEjAX+EYFel3Fw8FubeMAt5QCjIGOMV5N4gnZ9ZmXJUKeARn9albjKr3ZctsGCe5bpXo/g2AjwvBLK2PMZn+oBNeW54JKq31OK9Q0iZrLw7ZQl1+aMAegGM8e9NiOf8XX8f25WKAnYBhvTNc7JqoKrtt0yKueIZDJesflIDE8msSUjIG0cHJKjrQgO48GT745pjmOQsEUKeD6Z9qu/EO4dbbTYGZUcFnbb054/p+tVfBFqW09D2MhkIPU4P/wBaofiNNnWYIg7ZWIAjrz/n+VLqM5Zpn38urqDjOMZr0H4ZRBo9QldVBZo0G09hlj/SvNiSXx1x616x8MLbGhTyFVBeUjjvgCiWwI1fF0pTRUCHHmToPwGT/SuFup2VdufrXW+OnnC2cNrGshyzsGfbjsP61xU6zP8Aeiwe/wAw4qUUYesM8ojhRS7yPwoGScU9dKurWFRKCZTkuofoT+FXrOJ7XXLa8nA2LuGFOdvBxn8aW7u2Lu5VtuSc4qyTEu3lgynzbiOMHvXpQ0mF9Dh0+YfLFEqAjqCBjIrgdNtZNT8TW64/crIrHPcDn+lenV7eW01KEnJb6Hk4+o1KKXTU4C70+awuGjl6ryD2I9RToLplFdbqdtBfxi3Mii4z+6A5bPpjqaw10nV03L9hnJX737quDFUVRqWT0O3DVnVhdrUqtdsQcjg0sc4x05qy+m6iFzNZTICQMmIj+lNawnXrEwPoVrnTR0mjoWpHT9YtLsdYJlfj2OTX06jh0V1OVYZBr5USKWNgXiYD3FfSPgy+/tHwbplwTlvICN9V+U/yqhG3RRRTEZupJiZW/vCqDGtXUkzbhh/Ca53Vrn7LpdxKDyEIX6niokWjgtUn+16lPMeQznH06Cs507VYc81E3JrFlEDRg0xY8N7VZxk0pSpGJGqhGLOsYCnDN0FZNrJJcZmnIZmOAQMcDpWnekw6VL+4aYPxuGPl+tU4I/LhRcfdGKpAMupFitZGPPHeuaI3sSerHmtnVpdsIi6FuayFXB9gK0RLFVSz10sBf7NGH+9tGeKwrGDzbpF6gnJrpQnFDGiWytmu72C3UcyuF+leqxoscaxoMKoCgegFcR4NsvN1RrhhlYE4P+0eP5ZruaRRa0//AI/4/wAf5GtusPT/APj/AI/x/ka3K0jsZy3CiiiqIMHUv+P+X8P5CqbSLFG0krBI0UszHoAO9XNS51CQfT+QrgPHevBV/se1fJ4NyR27hf6n8Kxe5utjm/EWsvrerPPyIU+SFD2X/E9ayGOKOpALBR3JPArQg1Dwrpzob43Gpuy4Co4hQN69dxFIRm8/hS0ybUrCe5ZbGKWHnmOQgn86GfCk0ATWuvReH9Shu5bVbr5HUI3QZGM/kTW3H8VdPbb52hQFVPTjn9K4rUbNr/YBLs255qj/AGE4bAv0yBz844p2XUR6WPiX4fkQpJ4egBbq2xTjn6U1vG3hOQIDoUQVSC/yL8w9K84OhXKoXW7VvTBBpG0O/CghwwY+lFkK56lH49+HLqBceFuVGN32eMk/rXHfETW/DGsw2g8J6Z9hEW5p/wB0ELE4A4BPTn86586NqaKD5iY/2kFVlsZ5NQSAkSy3EbKoQcFlIOB+FVoIyznrip1t3IUR7Mn+8wFbSeE9W3r5tnIq+4rF1GA2l/NEwz5LHr6UCNe18O38sZfbCqhdxLToBj8+KoxsJOhyoPJqtFN5kRBjQKRjIzUseIwEA+UCmIvoyryPzoebLKCM7jj8Kr+aPXNETB7gKBkrjH1NUhHuPwSs8WuqXrL95khU/QEn+Yr1WuM+FViLPwPE/wDFcTPIfwO3/wBlrs6YBRRUF9P9m0+4nPSKJn/IZoA+cPFEkt54hv7gRMwkuXIO09NxrFa2m7wMB6lTXZzXiktlG+Y9arSXSvDIoQ9Kzcx2OQksZyMm3I9tpqubWWNgxgZQvJYqeK777cg+ZkNRX+owXGl3FuFbdJEVX64qeYLHCyxhYDGeVZiSD7nNIIxBCixfKM4IFUri6uQwUxqOeODTklvpmCiFTzwBmmBbUZctnqeKu27qrZbjb0qSw8L67eKJbbSp5B/eEbY/lV8eEdUCEXtncWzDkDyWOR680Actf67d3V9JJcX90GifZEiykKqjpgdse1euar8TXvvhKUmtyLy6sxbvI/UsTtLY9wCa4lvCFz99fOznOfs3P51na9Z3Flp8EEjSFSxxvQr0H/16dhHIyMdzY9eabFI6PwxGeTU7QMWyFJyecCnjT5iflRj+FMCb+1JVBCEc9STQdVm8vyxIQO+04pi6ZcnkxNj/AHacNJuCDmJvrip0AQatMrk+Y2T1NPOsymPaZGIoXRpywBhb8jSvokwPMbD8KWgDf7VkPRjTf7SfrmnDR5/+eTflSnSLn/nk35UaAJ/asg/ixR/a0xI+c8Uf2PP3iYU5dGnwSY2/EUWQyJtSlcjc5I9M8VKusTldu84FH9kTL/AfypF0mbsh/KiyEP8A7WlA+9UT6vK3VjTzpE+MbG/EUw6Pcd42osgK/wDaDZ+8af8A2nIW+U4J6mlfSLjbxGx/Col0yYdUbH0pgTLqcqIwVjyOa6zwr4i/sfwvdXLKrmJ2cZ55wMfrXDyWkyZHlv78V0Hh22uJ9MnhUL5bnDByecj6UATaJ4/8Q22t295daq01vJIpltyBgqWwRgdOvb0q78Sr9b29DqrHco57AAn/ABrPtfCTxXSSYhbyzkAMfr0xW5eW1s+kXo1Rwswt2a3IGdzjHy5xxxz+FRKy1A8zQndxXQeFVaPX7eVV5jDMG9Dg1gr0KhlJz610XhKFxq4kdSF8tgGz1PpVvYDvtViW30O6kaRjM8S5yc8k5rydyQuAX55O6vStbllbw9cSEhVRMZLcsenFeZtwcDcPrURGXdF+bV7ZCQQ0gyPpzXrxsoLOzmuGPmSLEz727fKe1eS6Avma9ajO7D5wB6CvQtTv5f7FuiDyYWGPqMU3uB5bjjOzHvmrelIZ9Ws4wx+adBjH+0Kb/Z82MMqqc9c5rQ0Ozkj1uzcyKQkobH05p9APTdUdZ2Zo2ztHluCP5V5Xq9w82qTFnbbvO1SO1ekXlwz2kgB2nHUdTxXlk0wM8pyTuY9eMc1KAa8fRVUMScDJr0qaQ/ZYo0GI4IgB7/KBXnNsxa9gAVG/eLwee9d/cHd+7j5wAB9B702Bx+siNp5CYzn+9nmsgy59uOSOtXNRbfcSYDdSMk+9ZyjLABsEnHNNAeneF4Bb2OnqThnUk5689B+Oa5nxjcGXxLdEu2dx4A6V1+lzwiC3ZEV2iVQHI7gdRXnuqXJudTuJCxBaQnnpyalbjKa8tuIX8eK9q8CBbXwpaqdoZgXOO+STXjCnOBmN+MfMcV6jpkjW2nQRqxXbGowPpRIET+LrxZNYjUcBIgPzJNcxdEfeHfrT9VupJtVnYncFIUH6Cqhl8yP170ILkMj9T6U3cG6gEdwajkY88HmmxtkYwfypgFrJNpl8ZrfZjBClhkrmtWx1a6k1CF7q5Ypv5HQYPHQVly/d+bgdOaVegrWFacLWehnKlCV7ouXMRsbiSJcAxNhS3p2/Smi8mP8Ay1UfQ4rdi01NWukuJuYpIFZiP73T+lXF8M2PP3vrmislGo0h0m5QTMCC6nYfNOwPUAMSP51Ib2cffkY/jWn/AGLDDebI2Pl7eQfXPFLPokW8KCRxzWSaNLMoQ3U0/Ejl19Ca9p+Et753hu4tSc/Z58gegYZ/mDXik0C2U3lpyMetejfB/UPL1y6s2PE8G4D3U/4E1oiT2GiiirERXKeZbSL6rxXA+LLjZZxQDrI+T9BXodeXeLm/4nckXaEbR/OonsVE5yTvTBT25poXmsCwxTscU3pTxSGUNSR2a2VJSEYnzI/XHINAXHFJKN+pSEklVwAN2fc0XEgigdzxgVSA5/UpBNfHHRardU56k5NIWMjM2eScfhS8buK1INfRIMmSUjoNo/rW0Fz9Kr6dAYrKMEckbj9TWjb27T3EcKj5pHCj8agtHZ+FrP7NoqyEYadi5+nQf5962qZFGsMKRIMKihQPYU+mMtaf/wAf8f4/yNbdYen/APH/AB/j/I1uVpHYzluFFFFUQch4v1ePRY7i5bBlOFhQ/wATbR+g6141NK9xM8szF5JGLMxPUnqa6r4lXk0/jO5t3fMduqLGvYZRWP6muRNYvc3WxXvbdrm2ZEbaSODWbDpV4sXltNGgzuBV26/RcfmSa2etB5qRWIIraOOVpusjdTliPwyT/OpHXIwKU9qDQBA0ZCnFc1ceGJZWciUZb19a6o03YT9aoRxA8I34fJukA9VzmrSeGrtF/wCP2TPqHNdaYSeg4pDAwGAKLk2OMvNLurK0eaS+mKjovmHk1U0bUWs9csbiVyyxTqzAntnn9K0/Elz5l19mQ5WHr7tXNsMN1q1sI+jzdQTRjaykV5V46tBB4ilZcYnQNkDHOK6rwjrCXuk2xkAZyoUknuOD/KoviNpEr2NvqEcWFQFW2jOB1/qax5rSsW1dHm8RxHtxwp9Kf5mG4NQzTv8AJufIUHj2pgmUrkH0P51sZloyYXNX9Hw90kj9FG9ifbpWLvLMPYmtGGbybMjON/J+nYVQj3jw58T9O0rw7Z2T2UzNFEAWVhyev9a2E+LOmN1s5l+rCvCbfXJ0t4o47GFgqAbiCSeOp5qb+3bngGygB9lP+NVa4HuB+LGnAn/QZv8Avsf4VQ1v4oWl3od5bW9nKsk0LIrFwQCePSvHm1y63HNpCPwP+NKup3N3Js8hIwQTkDpihqyC5spqcbRqZWIOORjvQl9beWwJOT7VhSPdZVScAjJ+UV1+jfD7WdU0+K6MLKk3K7uOPXpXO0UYcmpwiJQzHIHNV/7QtQwO5yc+ldonwqvQQ9zbMwzyquf8Klg+GcU0JP8AZl7HyRl5OfyxU2A8hna4+2D5GO1jt4rc0XxJquiymSyh2P8A3jCGI/Eg1203w0ujMf8ARrlVXocH6Y6VA3w3vEVjEkvy9Q2aoCCP4r+KVjAM8n1MA/wrt/CPxWtf7BU+Jp5nvjK2SkYxtzwOMVyFv4A1B7mCGaOSJJnVGcrnaCcZrmvG2g3PhrxE2n24e5jESSCReBz2/SpU/f5R20ue4N8VfDSqD5lwfYRj/GvNfi14t03xPBph0wSYg83f5igdduP5V5rI98Mlrab/AL6ptxcXstiI5dyBT8oYD8/etnexOgsSkSFSMHuDWnbdOR06/Sq2k6dfaveTNuPyqNxVPwH8q1P7C1JCQhkwP+mdRcBipNJMXj4TbgAitCKNlj+YA/j0FU10/Vo8ssj47/uuKVodY248zIx/zxFTcDTCBh+FMMSkD35rPzrIziRenTyaaP7WiY4ZAW6/uhzTAtlSAe2c9KljyfmHIx0rOLamxHzoQB2jpVbUl7r9fLpDNJgpX95gAjoarlQynG7r69aqSf2lIwDlCP8AcoUakv3Sn/fumIueSAnztzioDIIsAg5J7UwnU27x/wDfumsmpnsh78RUrgXEQs5/SpZYmGMc1m/8TVASu3pnPl9KR7rVl6LBn12f/XoAvrGwjAYDJ6io2gBUkKBg9qzzfaordICfdD/jUc9/qu5DiDjPAU8/XmncZLqSn7qDIXhhit/wDqum6ZayDVYN+8qy/JnGAc1y3/EwvCx2xbj1+U/41l6jdalYRwKCY8ll/d55xgU1e+gWue62Xi/wst2WuLPC7jg/ZweMVxfxX1vTNTttO/sGLaiyN5iiPbyVHavM11jUifmnmx9a6Dw1aX/iOSaPzGYwlMBvfP8AhUVW4R5nsVGCbsjj7m2+yXDxSKzMuOVPH8q6HwdIJL6Vdrjy48/Mc9TU2paXdx6pdxNEpMc7xnH+yxH9Kj05bzTbmSSOBXMgCnfnjHpTUuaNyLWZt60ry6fNEoLFhlR6Vw1zA9pIqTKQzLuGOa61tR1Bg2bSMk98n/GqE8l5NIXa1iyQB93P86E7AV/Cw3azFKJAfLBJTHPpXX6gss9jKkX32XjJrlrKS6s703C2yElNu3GMVqHW7vHFmvtljSYGDqDXFhMI7hgjMMjC7sip/DMrXGvRDzmYKrOQVwMYx/UVZu7i7u5lkeyjyBjB5/nSWL3dnqBuBZK3yFNoGMZIOf0p3A62cCZJELDcIyVX1OP/ANVcBd6ReQ7WkK7ZBlSxCg+uM10r6vcSZD2JAIx1/wDrVmXyzXrqwtWUKOACf8KSYzP0a2Y6vanEbgNkjuOK7hnMUMgkj4ZeGrl9PM1jdebLYtIMYAzgj3zitI6xK33rOQj6/wD1qGwOXngJuWZsrljjcRg0llYvNeIgVTk9S2cCte/Z7xo1+xFVUlioP3v0qG0Sa31BLlbPCqCAoyM076COyiRorRMOu/ZjjtXBXunz2rmS7KxKT3P3vpXTjXHK4NlJn03f/WrN1Z5tVhWOO0IKkn5+eaEMybHTrq7kikitt0MjcPjIxn1r0NHPAHbiub0++axsILb7HKfKQKSD1Pc1cGuEA/6HPnHtSeoyu2t6et0wdZW3MdzbQec9uaxzHoA3F9S1FJcnKLCu1fQZ3ew/KoP7OuGYsUY5Poasi2nX/lghPq0IJqtCQVdACnbf6mMdMovvj+L2X8qtqPC+z/kIawpHTCp7+/sv6+1V/KnPH2eFfrDiplspiMn7IO+PL5/lSKHsvhQow/tHWD1wGRPfHf8A3f19qbCNHeNCl7cqSoyroODjpkVFLa3AyEjgY9iI+KS30xtyLM8aJn5m7geuKBnb6Hb/APEph2SF4yWKMQRxmtGS3KxFg2Pxpi3eiyW0UGkXFzuRQu1xwFA7VDKJmjJjlZs+rL/jV1XzRjPyt93/AALGdLSUo+f5/wDBuFtA0sjEtxnr9KjvFMbbiT6daLeaOBTuuZEPTATNQXbyyKTbs8wx3TFYI2Me72vMzrcKRnheciug8C3h07xhps4nQqZhGwz2b5T/ADrknt5o5CJE2nrirEKNEVk5GDnNbozPq/I9aK+Yf+Em1Lf96VRn+/mp18UaqB8ktyMekhq+YLH0vXnPjq1EOt+aBxNGG/Ecf0rzMeL9XHSW6HrhzWppOq3OqQyyXbSsyMFHmkk4xUzd0NLUuNgHFISo+7096VjzmkI5rEsQilJCRlj2GTR1qC+b/RRH3lIX8O9ICpahihd/4zu/OqutzeXaqgPLGtRYscVzmrzCW8KDovFaIGZ69R/nmrFnD593HH2ZufpVcYx9a2NAhLSyS9lG0fWrZC3N5fuYFb3hW18/VvOYZWBd34ngf1rCUdq7jwrafZ9J81h807FvwHA/rWZobVFOpaYE2nf8f8f49vY1uVi2H/H9H+P8jW1WkNjOe4UUUVZB4P8AEi8gi+IOopI2CPKzz/0ySuYF9bHhdxz/AJ9K1fig2fiZqw9PJ/8ARMdchHIWJIOMVk1qap6G0t9bDG7cfUD/APVRHf2m/MwkZPRGwf5GswuQrbeSBVF9R+dRGm4MSo9zjp+ZxS5QvY6VtR0voI7gH/rqP/iaja/08A/LLnHH7wf/ABNYEdxM0u2SLYVIVwW5Vsc8VK0yqxByAOS2OBTsK5qyajZg/IHH+82f6UkOrWyZ875z22kjH6VjfbYM/eP5daX7VFklecAnHtSsFzcbXLFI8+W3oG3nGf8AvmkGrRTRyLaJ++RCQHPGe3asFr6JHKnjHFWbZvL1aMdBJGR164osFzmrli7FmOWY5J9aoyj2rS1CLyryWP8AuuQPpmqEwGBxVIk6LwZ4iGkXDJKu9c70B6Z7131z47t9YtvsF9DGsEvyMQemRjP6140hKsCvB7VfSdjwTUyim7jvYm1K0NreT2xIOwlVb1HY1RMZ3Hp2q9NO86L5oJZRgN7VUKkmrQh8S/NjtnJqd5PlB7ZFRoABxTmUMMHvTJOx0WQXGmo644yuB7Vo7fSsbwjk6fPGedsufwIH+FdBtFK47FfYPShf3auxHRScfhUxX2zRs3ZXHUYpXHYzk1u2kulEsIMY2ggHBIzzXslr8U9IS3hjSzlRAgCqGHygdBXgi6Q7XjIJgpQA5IrQXTLnAVbuM+9TsB7l/wALS0w/dtpD64ccUifFLTXAxbPg9MyCvEBpN8hLJdDjmoRa3sZ4uEyPU07sD3hPidpzvtNs6e5kFTDx7YzuqqqryT/rASeO1eALa3xB23GcelL5OpqvEx6dQaWoHs3iT4n29ppM6wWzJdDaY2YhlB3CvML3WZ/Ecq3dzhpEXygQMcDn+tc5qMd9DZyzXEjvGMEqTweRV3wpMLqwnIGNkuMfUD/Co5Vz8xV/dsWpLUtnI4+lZepFLS0QuOd2B+ddQIctk8DpjHf1rnfFtowtYQOCZDz+Fat3RmdJ8PfGGm6JBetdWwlknYfMSOAK7CT4oaKUY/2flscAEAfyrxez0W7Kfu2yD3Aqc6HfgjL4/Cs+VDueqzfE3R2+b+zAGzx8w/wqBfiboqE/8SdWGOnm9f0rzL+wL/tLSDw7qB3fOPy6UcqGehT/ABC0uWRGj05Ijzu+fIPH0qNviBpJRANMXcoGW39T+Vefjw7qDdXHX0NH/CMaj3kXP40cqA7+Px3oq9dJ7cASY57dqpt4vsuMwqcnJ9/auJbw1qB4aUfXkUq+G74AAzKPQ8miyA7i28TW0zuIrRJNqF8BecCq6eK7AuQYkwfYVU8M6O+mxSy3Dh5JMAEdlH/1/wCVY2s+GJ01CSSzfEEp3KvPynuPpXbPCONCNXv/AEjkhiIyrOl/XmdGPEtjx8qjr0HWmHxBZMMY5IAJFcYdAvVJ+f8AnSpol6GwHz+dcVjrOz/tqwVGBXGRjNMk1vTmUDy8BTlff2rkv7Gv/U8/Wg6HqBHzZP50rAdUNSsJGVmVQcdfWq097adY0TIxg54Fc8ug6kWHyt6AmkbQNSPZvpTsB1+j3+mwzMblEOSCOetY3iPytRvIm05CI4y+QB3LcVkJoWox5O1v1rrPBmkPJpkxuBllnK8j2FUtHcTOVXTJgy/IxJPQitzw9rEnha+8z7OsnmupZH4yF/8A1120WiKTkge1effEhPsGp2UcZ2/umc4+oH9KitapBwfUqF07m4mv6bPeXU80A3z3Mkh9tzk9fxps2tabJMWe2Ujt04rjItF1GSMSr91vmHPrT/7C1DHAIqYwskkDep2C6vpX8UCNxgc9DQ2oaS2MQIvGeBXHHQNR2jj8c0DQ9QXOSP8Avuq5RHXNf6ZziBAd3GBnApPt2llQ3lAEGuSGiajn5Rkf73Sj+wtTY/dOf96jlA64XmmcbUHTHOOOalF1YZHCg4/h5BrjToOrKPuH/vqmrourAZCn6bqXKM7P7Rp3ccY9M0iy6fs9z68Vx50nVVP3W6f3qF0vVWYDY+frRygdkk+mjPYEcY6g0b9ObcSw44A21yH9j6x2hk/Om/2Xq6qcxye/NFgOzB0zuO3JOKcH0s9wDjkY61xX9l6xt/1Uh/Gj+zdYXrDL19aLAdyP7J4ywxj5h61KBo7LlpAnp3zXANZayMAROPrTvsmsAfNG/wCINLlGd4sGkk8SheM8mnNb6MTxPg9BXBrb6tjJjkz7Cm+Vq/8ADG/XsDRygd+LXSPlUXC4PHHb3p4sdG4xeA9QeelefeRrO7PlSZ9cGlEWrBsNDIR9DS5Rnoq6Zopz5l32+XnqaVNJ0YjJuVHOB83SvOQNTBx5Epz/ALJp4Opp0hnx3+U0coHoy6Norrn7YBjsXH509PD+jkE/bkPPGWFebq2qZ4hmA/3TTy+qDrFNn12mjlfcD0tNB0qJGlhvVEyAlV3DnjpUtn4W0W5tY3kvo4mfBdCwBWvLHn1THCSfXYa0dXmvS1rdQs6maFSwC8bxwa3jFyotX2d/v0f6GL92qn3Vv6/E9MbwDpEsZVNVtwexMi4B/OqGn+DtHt9QFtrOpeUzfcaJkdGH17fSvM/tl6V+aST6AGkF5c7tzOxb3BrFRfVm1z13WfAmiWtmk9rqvmFZk3K2AChOD/jVbVPC+mR6bcS2d0r+WmVGOvOK8yOsXbxmNt+DjPPvXSeG7qbUbplkLCONMn0J6D+tVZ9w0K48PoBncenoaU6Gir95h+JrqzbKWP7zHGPu1HLahk+VwcDniq5gsc0mih+Vcj6sa29FtFs7RlDbizkn5s1YiiVEG5lAzkk9hWR4fvHnhnmk6S3DsoP93PFJsDeI5oApVO6gDrkVAxOh5qncN514oHSNc/iavbazbUb5ppezMcfShATXE3k27yscbVzXGySmSRiepNb/AIjuhb2CR5+aV8fgOf8ACuYjbnmtokstKOcCup0u38iwjXoWG4/jXN2EJnuo4x/Ewz9O9diFx0pSGiWCFppkiT7zsFA9zXpUEKwQRwp92NQo/CuL8M23naqsrDiFd349BXbqcipKFFLSUtMCzYf8f0f4/wAjWzWLYf8AH9H+P8jW1WkNjOe4UUUVZB84/F2ZLT4kajJKG2SLEOBnkRJXEf2rajp5n4JXe/HCzI8UXU394ROP++Ap/lXlpnyBnIx1I7moNDaXU0dSYoZ2HTISr2hW8N5qaZtZFWHMuXXABzx+Of5Vh6dfLH5i+XLJk5G1c4ruPD8f/Eu89kZGmOcMMHA4H9a68HS9pWXZanJi6ns6L89Cj4jsI4WGoxwM5ziTYM49Gx+lYEl1E7fNazFsdl7V6BJGssbRyKGRhhge4rhtSU6RqLQurEY+RgvVe3Of84rozDD8kvaR2f5nPga/PH2ct0VRNboQRZy5HIyn/wBekFzGr7hZz+mQn/16bcTi4+dIpQD1KgemD3pU1Haig21wxAxnZ1ryz0hfPhDDFnMPcx02O/STUreMo6MGwQwxwRS/2kP+fW4x/uVm3lznUYZ1jePp98Yzg0AWtfjWLUz5YAUopAA6Vln5hk9BwPat3xJHua2mXkOpX+v9aw2IWP8ADmkgIUXDn2qxEMt7VAvHU1OhwtMRI8h6Coi/50jNUWaYEok5zn6U7zPWqwY04NmgR2HgmXddXcXqisPwOP611zxj0rh/BMm3xEqHpLE6/wBf6V6BInPFSy0VNoAOetJGhDg9qsLH1p5i6MBgUrgefaiDFqNwgP3ZWA596z5ZnB4dvwNa3iBPK1y69C4b8wDWFI+WOT3qiBZLiUDiV/8Avo1Es0pk5kfA9zQ3JpinGT60AWVmctw7fnT/AD5P77fnVZJBg5HenbwaQGlphWfVLeK7YvDJIFYM3HPH8676z0u3sN8drHGoYKzbGznrXmStg5BrsPAcjzX93G7Fv3SkAn0P/wBesnF8ylctPSx1awADNc38Qrdh4eidOD54AP4Gu0EHHT61z3xCiz4PDgcrcpz+BFXck8sa6nSIBZZAB3DGoVvLjJP2iX6bzW/dXWkD4awWUe1tX/tFp5CF5EW3aBn8jiuXz8tUtRFg30/Tz5P++zSG/nIx9omH0c1UJphNOwXL66ncL0uZ/wDv4aX+1rr/AJ+Zv+/hrOzRn0osBo/2td8/6TN/32amtL2/vbyG2guZzJK4RfnPUmscnmprW9nsblLm1kMcyZ2uADjPHeqUY312E27aHuEEIt7eOFSWEahQWOScdzVfVLI6hpstvHI0UjDKSKSCrdvwrzLR/Eeqz6/YLcahcPG9wispc4ILAHIqnrt5eJrl9C91OVS4kUAyHAG44r25Y2m6Xw6bHjxwc1U+LXcdPqOo21xJDPc3CSRsVZTIeCKYNYvR0u5x/wADNZhcnknJNLmvD5VfQ9m7NQazeg/8fk/H/TQ0v9tX3/P5P/32ays+9Ln0pcqA1Rrt+P8Al9uP++zT/wC3dQ7X0/8A32axwaeKOVAa41zUuMX1xwf+ehr1v4YF5/CUs0ztI73UhLMcntXjeneT/adoLplWDz080sOAu4Zz+Fe2/DGIDwJCV6PPKR7/ADkf0qZaAjpioHArjvEugWuteIl+2KzCKFFG04xksT/Su2cdBivMfiJdeVrkaQsUlCDeyt1GBtH4c/nWM4uSsmaRaT1OTe7njmdIriQJvIUbugzx+lC312GP+kye3zdKq5z1NPQ88VqlZGZa/tG7x/x8SfnSLqV4P+W7Y7c1GAD2ppXnkUAW11K8HS4cH604axfKfluXFVVHFO2CgC1/bd/jm5Y/hSjV77r9oaqez2pyj8qBlptZvh1uG/Sga3fg/wDHw35CqjLwabigDR/4SDUgOLpvyFL/AMJJqf8Az8/morOCimlO9FgNRfE2pjjz1P1jU/0p3/CS6mR/rY/+/S/4Vk4HcUoxjFKwzT/4SXUcgmSPj/pmKd/wlWpkffix/wBchWSVBFMAxTsgNf8A4SrUx/FF/wB+hT18W6mOhh/79CsbaKNuKXKguzb/AOEu1PGCIT/2yFIfFmokfdhJ/wBysdQO9LgY4o5QubH/AAlV8VGY4T/wGnDxRebf9VEePQ1jBRT41UNRZBc1v+ErvgMiOMH2FNbxVf4yEjPPORWfLGucr0IqJQA2G6Z5osBsR+ML6L/lhAw9CvWrw8TzS6RLeCzt98coR48HAUjg/nWM9guwMvI6VJpce/7ZZHnz4SVHqy8j+tb0EnJx7q3+X4mVbSKl21/z/As/8JfcsvFrbhfTbSDxPPJwbeMD2rBUDpSgYNY2Rrc2m1bzdv8AoyYByeetdj4Sj+0WL3Pl7N744HYV55F1Fer+HrR7bQbaMjY3lhjxnk8/1pMpF1YBzwaSeACFsHrxVxI2AHzA/hTLocBfxNSUYl8BHYTHJGUKj8eK56HFuFEYwo4wPSt7X28q3ijzy7ZP0H/66weo5pks2rSbcmO9XFGVrDs5SrAZ71tQvuXNSxkd8/k2jkdSMDHqarwReXAF79KffnfPDEemS5/Dp+pp/wAqgkkYUZJPamgOP8UTGXUPL/hhXb+J5NZFu275SeRWjfn7TNJIf42JrL5hlB7g/nWqIZ1fhqDdcSSkf6tcD6n/APVXRkYrK8Nxr/ZXmg8yOSQD0xxWuEaR1ReSxCj8al7lrY6fw3B5OnmU/elbP4Dgf1rfjfis+CNYYUiXoihRVlGxSGXQc06oY3qWmBZsP+P6P8f5Gtmsaw/4/o/x/ka2a0jsZz3CiiirIPGfjHZC5uZJAOceWT9UBH8jXhUT7VwxPytnA717x8VtUjXWn05MM7FJJD/d+QYH414fe2c8N8/kwSMoc4KqTWd9TW2gljdhL1dqsVwRgck1vv4kvwirbxNEiqAAIc9Pqa53ybqN4SLeY7GBJ2HmtRrrdGV+zXHIxzEa0jVlT+B2Mp04z+JXNm81q7isbGUibdNFl9igfMDg1i6ld3F5LG/kzSBRgh2/lzVi+RpfDens0c2YmkjIEZzyQelVraZochobht2OsZFaYipKUtX0X5IyoU4qOi6v8yrF5i25jktZRhty4GccfWq8lxFCRHKkiHHIKe31rXa5Zm4trgf8ArKvlmuLjzI7OY5XB3R1zXOixAbqAuWyw5/55/8A16jvruGa3hSPdmMnqMdacltdqRmzmIyN3y9armwvGJ/0Wb/vg0xHQ6g/2nw5bydWjKnPtjFYEvLceua3beGRvDMsc8bI6AnDDng5rAJ5NSNiYzSs2OlNzzTS1UAFqcqkrntTFG5hirXl8DAoEQbaeqVKI6VU6UAanhuTyPENi/8A01Cn/gQx/WvT5xjBryi0Pk3MUg6o6t+Rr1p8FAeueQahloii57VOzZj2kColGW4NSlSV46CkM8/8aL5OtMf+ekSMP5f0rlmbB/Cuy8exf6VaSdmiK/kc/wBa4pzx9atGbGmbHWlZvwFQFC0gGOO9OdvzpiJOnHX6UbzUecUZzzSAsITXZfDpseIpFP8AHbt+jLXGxAnBroPC+spoGuw38sH2iNFZWj3bdwI9fripYz2QoBH0Fcx8QIg3ge52/wAMkbf+PAf1pR8VNNPXQZP/AAI/+tWX4l8f2GteHLzTY9HaFpkwspnzsIIIOMe1StwPKW681A5yanYcmoXU1qSQnmmk1KF65prL6CmBETRk07YfSgIaYDM0Zp5Q+lGz2oAlsZfJ1C2k6bJVb8iK0fFkfleLNQX1l3fmAf61kgHORwa6Dxmu7xNNMBxNFG//AI4P8K2WtJ+q/Uyf8Vej/Q53NKDTwuD0pQvtWJqMpecU8rQQfSgBo+tPX24pAMfWnqCMUgHr717/APDZdvw/07/a8xv/AB9q8CA9q9V8L/FHRtD8NWWnXOk3c80Ee2SVJVAc5JyBj3qJDR6cRub2ryr4jKo1hpNozvC57/cFdFb/ABd0a7uEhi0a7QtnBadewz6VyHjLU11SaS6jQxo8wIQnJUYwBmoW4zmM09DyO3vUAapIyD14/rVklvhWKghsHAI6GncdSM+1Qr0yKlHTigBcYpwpo609duRvztzzigYhHrRTwpI/rTSuDzQAmNxwOpOKb3wKd+lKqj0oAb060uO+cU7b7Um2gYxkIzk98U3GOtThcMG4OD0NJLtd3YIFJOQF6D2oEQ4/GkIp2KQj0oGMzzS9aCvWheDzzQAqn09aA2TShQfpThDtPrmmAnQ0/DBQ+CAeAccUhBzyKcFdkkIViinLEdFpATIN8ZHp0qF1w9TWsmxgWUOMEYPH40+cfLwOvXmgZLDehbXZIO2361FaXnk6rbzZxtkAP0PB/Q1VYZUr69KgIIGT9PpVQfLJSXQmS5ouLLOo2/2XVLiHHCucD2PI/So1rQ1n98bW8H/LxANx/wBocH+lUEAPFaVoqM2lsRSk5QTZd06A3l9b245MkioMD1NezxQhI1QdAMCvM/BNn5/iSFiMrCpkP16D9TXqirXNI6IjNnTFV5smU+lXgO9VW2/Mx6dTSKON8Q3af2sYiR+6ULkkADvyT9azkkDKCOh4DA5B+hHFULB7fWdaml1KSNbaa4LkzMypjPALLyoxgZ7Ve/4RmZWeWzniFrbtiUC8iZST0IOeRRchk6cMCMg1s2cgKg5zmsSDcYxu4NX7e6EStv4wCRigCZiJbueZjhI/lBzwAOtctf6w+ozlYmK26n5V/ve5rfuY3bQZ1T77xkn3z1/rXKQ2jxv0NXETLCqWUVWuLcn5gCcda1oLVnA4/OpTZkN0piM3SL6fTbncg3I+A6HoR/jXpOhw+fqCvj5Y138jv2rkNO0eOS4E8w+RD8q/3j/hXf6BCEtHmPWVuPoOP8allo2VNPBqIVIDSKLEb1ZRs1RU1PG9MDTsP+P2P8f5VsVjaec3kf4/yNbNaw2Mp7hRRRVkHz58T/8Ako2qe3lf+ikrlNzHqa6z4mjPxG1T/tl/6JSuUOBWD3NlsJjgktiopZAiFmJwPenMTWffy87FPTrSGXWvZG8NO4b5o7kDp0BWsg6jPn/Wn8hVuzPm+HtUQ9UMTj/vrBrFbNb1dVF+X6tHPT3kvP8ARF8X85JPmmon1S55xM35CqTM3QVC5NYmxcfVrw8faG/IVEdWvP8An4eqnNNRTJIygElRubHYVQi6NRu3jIe4kKsMEE1VJ/CpCUZf3YI7EGoippCGnp1pmCenWnbSamiiPHHNMB1tFznFW/KPcc1JBBhBUwX14H0pXAreUPc0BPbFWCBzjt7URp81ACJH7dq9Ot3M2mW0gP3olPH0rzmMKDzz/WvQfDjed4ftieSqlfyJFJlItKpUYPBp2BzzUpjLdSPxpCmF4qRnI+PEzptrL3SVlz9R/wDWrhsLtINeh+Nod3hwtjJSZG/mP6153INoA71aIe4yTbtO3qTVb+KpyMRnNQBcjpTEITmnLQEJ6A1IsbZHB/KgRNCDVqMcZx+BqOKMjHBH4dKshCRwD+VIBAOKRwSpqfyyf4TxUiKCOV/SkBz7x7XPFRMme1bVxApY4XFUpLY/wg/lRcDOKYpNmTVloX/un8qFgf8Aut+VVcCARcUvlVbW3f8Aut+VO+zPj7p/Ki4yj5VJ5XNX/s74+4fyoNs/9xv++aBFDy63PFKb7jTpv+eunxMT74I/pWebdx/C35Vsa3C0umaPIFJ/0YoeP7preH8OS9PzMp/HH5nNeXS+XVv7PJ/cP5UfZ3/uN+VYmpV2dMCjZmrQtpSceW3/AHzTvs0g48tv++aAKgjpdtW1tpD/AMs2/I0v2aTP+rb/AL5NK4FUJ8pHamYIPWtNLR9v3GH4Gm/YW5+Rv++aAG6USuqQZ/vEfoa3tUz9gJPZlrHs4Hi1G3JUj5x2rb1JWbT3ABJyOAPeoe4zBBqUdv60xY5M8o35GphDJ1CN+INMRNHwBmpcgD3qOJHPVG/Kp3tpY1y0bAZ7igBitmpAPWoxG/8Acb8qcFcDgH8qYEwJI56UjL8vFLGpK9CPwodXHRSR9KAIue9AJFKUY9j+VIqHPSgB3PrSbqUDLMpBBUA8jr9KTbyPlNADhkHPWm85qRSR2oYA8jigCPvTcdeOKlxSMuKBkJ9B1po9alMZHNNCHNMBFJHGKlB4pEGOR19akC7RSAbtB60jbwxAJ5689afj2qRYiykqM46+woGRR4BHqetTyJuTcOxweaVIAytubYcfLxnJq3a6fcXMZeFAwU4IyKQGU4wfelVFfIYhcqSSfUVZnsZ4pGV0wwPrUF1b+W7IG+76/SmBbP7/AMOkZy1pPzjsrf8A16z0HIAq/ov777Van/l4gOB/tLyP61SjHzcVvU1jGXlb7v8AgWMaekpR+f3/APBuehfDqz/d3d2R1IjU/qf5iu7VeKwfCFsLXwzbL0aQGRv+BHP8sVvqeBXI9zqQSfLCaw/EFz9k0C8kU4YxlFx6tx/Wtqc8KK5HxtPizgtlP+sfefoP/rmgDjdH8q03pKrFCONp5BrRtILKKRp41DS/whowOfrVKNY14IP1q7AUXoKCSwoIHzHJ6mhnJbNJvzTSeaANiylWWHtkcMKa2lQHlPlHp1rPtJ/IuATwh4NbW4duhFMCKK0ijpZIIs7yOF7U7OaeD2oGRhZJGHl5CthVGMZNdnbRCC3jiXoiha5vS4vP1GPP3Y/nP9K6ZaQ0TLTxUYp4pjHg1IpqMdKcDTA1NLfN9GPr/I1v1zekH/iZRfj/ACNdJWsNjKe4UUUVZB8//EzA+I2qZ/6Zf+ikrkyPQV0PxRv0i+J+qwuOP3PP/bFKwP4eM1zvc2WxXkOxSaypELMSTya15Y9wxVZofSgBNJi3QajF/ftWI+owayDDzXSaRFi/2f8APSNk/T/61ZzW5LdMCt560ov1X9feYR/iSXp/X4GQ0J9KiaD24rXaEYPtUTRCsTUyjDz0qa2hSFpXA+aRCjZ54P8AnrVz7OCwzyKPKA6Ci4ilJGP4VxUTRE81oNF+PrSCLNAFBYOatRwjIyKnEIFShQCuB0GPrTGNC4OMdKfIArFVZXA6MvQ/nRt9KUpx0pAQk57Uq9s/pSlcnFKBgYoAUCu48HSbtEdD1jmYfgQD/jXFY4HrXWeDHPlXsWemxgPzFDGjpSOM0ucIMDvTM84OanVRgYOagow/E8Rl8PXgbqEDD8GBry2QFpPxr2LV4hLpl1GCSXhcAfga8pFqwj3tkH0IqkyGisuM4PCqMnjtVczlehI9P51fmspY4Wchgj/Ln8OarGAEevpTuIalw64+dsjp+H/1zVuG4YfdkY7c4yfQbR+pNV0gG/kdun61Y2rHGWbaoA6ntQI0oL1tzKsjHOQPxwg/TNXVvxJwGOHPHHZjj/0Ff1rKtEXZH86ZIGCxxn86uxW4kK+W8R2nICyLzxj196QFpb4vhi5w5BP4ksf0UVE105fzDI3OCfry5/pUgtJAPupj/eHpj+VU1ILSqcFg2SMdARx+lICjdyylx+8OVHPPoMn9TVOWVgCPMb5cgc+gx/M1fnQOWBHXqapyIAx4600IgZmycSMOo6/QUolYt/rHOT6+rf8A1qZ8huGA6gdMe/8A9epRH0/QVQFmG5f5SZX5Knqf7xb+lPS5bamZn/h7nsGP9arJEFUD0HehyqyRgkAknA9eKAJ/tDKnEr/KPU9k/wDr0PO2HxK/Rh1PoBUTAcgDikCcnAznmgB7zMWI81uWPc/3h/hWrcuZPD2mPvYYmkUnP+2DWDMUTbvOMtxjv3rbO1/CETddl2V/Nc1vS2kvL9UY1N4vz/RmaZCpjxI3RTnd7NUIlbH+tYcf3v8AYp4jXJI4/GmTpGkRLYUYxn36ViaitKxDjzH6N3PoKcZm3HEj9T3P94VFGFdAV6H1FPKDcD3AoGTwzMrqfNf7w/iP98/41LHMflHmtyFHU+jCqyrjBPbtiiB1ZSFzlTg5GKQi6k5MZxK+Spz8x7x//WoupWIciRurHr7K1MjXdjI6HjH0xU2wEcqPypDKkIeTWbdQ2d0uME/7ef611d/bJBYyTGUfIRwF7dP61yKS7LkvA372N9w+Xp/kirk+sXt5avBcbNrYztXB4OfX2pMZJFfKVALsdygH8VI/pU329WBO9uQT09VB/mKzUHIwAPwpyyKLgx554AG3ocf4UgNqLUI0LMHbglh+DBh+hNW01KJGUbiQpA6dg5H8m/SsJVBUjsRipQ1AGyl+hChnbkBWOPYof5A0f2nHIFy5Bcf3e7L/APFLWG1zGszZf7nDKBnknj9akSbcoaJhjscf596ANw6nEVZ0bOMso2/SQf8Aswp41KGNsHBC/wCz2Vs/+gv+lYUYKAL2Axz/AJ96SWZFljQuqtySD3GMH/PtQBum+gGFdsYwrHb7lCf1U0wX8cnG7DNwTt6EjH/oSj86yFnE8YdCrq2cEDr/AJxRHkMST1Oee3Of50DNc6lG2GQckbgCo7jeB+YYUo1C2XvkKcjK9QDkD8VYj8Kxp3VCg3Kjsw2e5Bzj+f51GtxFKxERBK9sY46f/WpiOgF7bBSrMCB8pO3rj5SfyKn8Kje9ibglQx4JC9CflP5MAfxrGUfe5yD2P0xTbiYJAxkdUByAx7E//XxRYZtfbom5QqG6gbemeR/48CPxqM30WMqwIxkDb1GNw/QkfhWVHdI0xjyvmDkgD3z/AD5qTB3Z4xjpj/PrQBda9jBK7hgdWx1AGCfyIP4U1r1M8yKD0Py9OxP54P41SfaqliFCqOT6cY/lVdXXZEHZWMg4P97j/CmBoPeqeAy57AjoSf8A4oY+hpYbqNsH5Tnop/EgfllfwFUDECwPTrketPChTkcf/rzQBom5ttv3lO0c4H3hj+ZU5+q1HJcopIDL3yQo9gT/ACb8TWbHPAoBaRSGYqhHfHb8OasGPcoAwAD+fGMflQBI+oYYcopzzhRgHP8AQ/oaVNRkbCRHnOQoHX0H81/KqrwrnlR7j1pbaeNbt5FZIwrjPOdp9PzGaALEdyDcKJSTkjqPy/MfqKL2X/SCp5Pfj2rQuIBcxrJvjkHUlBj3pLq2DIkm3IPGQP0oGZ2nMttqEUo4AcH6Dv8ApmrE9mV1drVB96Xav4nj+dVVQdO9dRpFt9t8TaZcFchkEjfVf/r4rda0Wu2v6f5GL0qp99P1/wAz0aC2WK3jjTACKFGPQcVPtZenIpYsECpciuQ6io7BpCM4xXAeL7jztdMY5EKBPx6n+dd84BLM3TqfavK72f7Vezzk58yQsPpmhCZEKnR8YqvUitiqJLYalzxVffThIRQIkyT1rU0653x+Ux+Zen0rH3GnxTeVMrr1FAHR5pc9OarRzB1DLypqQN1oKNLSppY9RURgMsnytnqB61061zGjOEvY5PMjO5/KMZPzcg4I/L9a6tVpDQozUg7UirUgFMYDtSjinBadimIt6R/yFIf+Bf8AoJrpa5zSR/xMovx/ka6OtYbGc9woooqyD5u+J9s0/wAW9VOPkXySeP8ApjHWUFG2up+JQx8RNUx1PlZ/79JXLEmud7my2GN7YqMjPUCn4+poxQBJYOV1CHoBuwaqXKEXEin+FiP1qeE7bmNv7rg/rT7+PF/N/vk/nW29H0f5r/gGH/L31X5P/gma6+2abHatO4AyMnAABJJ+lWzHnHFRvLd2k0E1gpJSQFivXHtWJqW7rRXsraKWaK5RZVJVnjAB7etZjRKmSRu9DWleGWebyjK4SO4kkVi2QVcA4/Oqk8YzgHP0FAFFl9OKYVx0qy4B/CoyM0ARhR/FTwmcdKcsfzc1IFO3igBoixz600qQMd/apQePWlKZUH1OMd6AKpBPWl2+1WRFntThAR2z+FAFdQB1FbfhqQxXkpU43R4xn3FZToewq7pD+TqMeB94FcEe1JsaOqM7E0fam7NioN7jIa2b2IHWkBPURHP0qSiSS5YjB5rL1hTdaayMM4dSOPfH9atyNKT8kO71AH+JqMi5ZGxb4THLHtSEYuqQqtnHCBk5y1ZiafuIVFwe1b80Jlu8HkD+dMmiVEYD7pHJxyaaJOdltmjkIZMfhSND5qNGf4hjj3rVA6hWOD1VhkVE0QMx48sdh1Aq0Io/ZAX6lfl2kAD3/wAauWdnDFJ5gwDgjp64/wABUrW7R8nlT0YdDT41wBQBKY1aJgGKlhgMAMiqv2UQoRuLknJYgZP5VaAI46Gmy8g0rAZskfNU3hJJxWmU61C0XzdKYjLWzAm35JbGOfSp44OatiLnGKkSLB6UxFQ2/pTGsI22ylDvDZzk88Y/rWkY6d5eFAwORTQGYYMngUeR6itEw/NxThAMcj8KYGS1mso+bIHNa8Nuv/CLzRr0SZW/TFMaLngZFXbNM6Tfpx0Rh+Braj8TXk/yMquyfmvzMNYACajntlmTYw4yDx2xV8x56daYyE1iamfFbLEoRckZ5/PmpXgAJ2FiuTgkYJFW0i5qXy89aAKIhbjj6UR22xAqjgc81oCLpxRgBiMUgK8UWKnEWe1SKPpUgFIZnjT44pGkAYls5B7ZOTSmOPbjZzV9kDIagMOaQFJYvwoNkjXAlbO4VeEPGcU4x4oAhVPX+VP8ohunFPVTU6JuXnk0gKMtkkjFiTkgDI9jkH86IbbyUKjJ5Jye5NXygGMimlB0H60wIFWh4VZkY9UOQR9Mf1qyIs9OacY/b8KAKUUAiVgnQsWx6ZOakC4XBFWPLz2pyxcZxmgCnLCJUAbIIIYEeoOahjsylxJLvZi/UEDj2FaBTB5qSG3aRXdRkIMt7U0m9EDaWrKQix1FNlgEqNGw+VgQavMgx/hSKnzUgM5dP/fxzGRiYxgDjnirJj9aulQF4pjrkUDKbR46jOeuaovpqP5eHdWjPyEHGBnOP6VrGP8AGmGIGgCvs4z/ACphjq55eBwKYU56UwM46cr7scZbcARwOMGrsKbIwhycDFTomfepPL9KAK7Rhl/pVGbT1lduwIGQPUHINaoSlEWetAxunW32eHZuYrnIzWquWsmjA5HzLn1qtbwnsM1pQoRjPPapKMCCyMuqQxkHDuCR7dTXbWbQ2FwDaQiNQpULknGTk9aytMtC2r/vOTGjFT6A1oYIy3+1W1F3nyd1b/L8TGtpHm7a/wCf4GzHrcq/wrUg15whDIPrWKKHHGPU1zm5d1PW2j0mfbwzIVB9zxXDgflWzrUpSKKPP3mz+VZPv0poQnaj6U4c9R+lGR2UCmIVT6jNPHWmr9KeKBDcHtQDTuKMUwL1hNhTGeOcitFM45/GsWNivKnH0rcsgLoIB1JwaQyfR7KS4123kIIWNt3X0rvFWqGmQQxR5ijVD3IHWtRBmkUIq81IBShaeFpgIBShaeFpQtMZZ0sf8TGL8f5GugrB00Y1CP8AH+RrerWGxlPcKKKKsg8C+JY/4uHqXP8Azy/9FJXLf55rq/iUM/EPU/8Atl/6KSuTIrne5sthc+1NajFIxPSgBDgHgVa1EA3rN/eUH9KqZPpVq9+YW7j+KFc/Wtoa0pL0f5/5mMv4kX6/p/kV9vHNODqoBCcj360zJHWmZzWBqSSyFz/Cv0qswHNSk8c9KjYgnjp9aYFdgO1MCg084LHmm9BQADAY98UE5+lKMGnqMj2oENwdvNKo96dszzzikCYzQBLGwDc9M9qnWQHgDIzVZUI61MoxjFIZbAhkByoB6fWlFttkSWAqrocjI4qOFOtW0UkZqbDHudW8pGS6twWHP7s0wNrXP+l24UcZ8qriNiMLyR6ZodPlz/WkBSVdXlkVXu4doIyViwa3bW3ubaB2u7gSlTwgXHGKpxMsa/Mme/XpWtEr3MJ3YyEAPFAGK9uAGcjlj+dZNwGaUkDABx1reviyJjaMD3rCdFZjv3jnPTNNCZRb73FSRJlGOAewqUwjPynP4YpwgcDgZGOcGqERIBuwpKHuOxpWU5JKgD2qbYwx2+ooKH1B/CmIiwQMjnHemON3NWCvA7cdqNinkAUAUWjI56j1qMoWOa1BCQucArjqOahaH5cZ/DtTEZ5TBp6qPw9Kt/Zx90JnnIwaQwFQeCPxFMCHbQF9KnEfoOvc0gjxk4Oc0hEZjx6UbflHSpSPQdfakKHAyKBkZX5eB+tWbFT5N4nrAT+VRheORVrTlzNIufvxsv6Vvh/4iRjW/hsyNpJ9KXZxjtVry+Tz+dIY+nesTUrLHTgnrxU+z0IoEZoAgPCnmol+90yc96umHdnjPtTFt2Dc4oAhVCfpUu0jkdqlWECpCgPQikMgbAHTmhVqVo80KgzyaQxgQGj7NJMypD1zzVgRgd6ljZ7eQPE+x1PDA0gI9Q0x7SbGCUAGW245qunAxkdK0L3U72+2rd3G8L0AAH8qphcdMGgCM/ezSYyeOlSlKAvfgUACAjk8Up9zTjzTNpJ60wF6dOaMYHpTlXoCR+JqQL2yKAK5Gea2NIiC2rOR98/oKzSnPat63j8q3RPRefrXqZZT5qrl2R52YT5aSj3Mq/tPs7b0/wBWx4Hp7VRA544rpJUSSJllxtI5zWBLCIpWVXVgDwQetRj8MqU+aOzKweIdSPLLdCAErzzRs9qcO3I/OkOfWvOO8YV70wrU2Nw6imFeoyKAIiKTbn3qXbxgmgJ6EUxkarjvUgBxxTgnqRipFQdyDQBDt5pwWphGpPFOEPNIY63bHHQ1rW8BmQbRk1mxx4bIXPua0bOQLgOx4/SpYzTjgEVr5m3Dp94gdRUMk8TbkUMM9MqamLSeQ6x/OGQgVO1ktvYRGZhJOPn4PT0WiMnGSkugpRUk0zNL/L749KkhkjlQDJDD1BqJ5FyTt25J49KYirz/ALRrWtFRqO23+epnSk3TV9zO1VXlvvunaqgA461UCkcEVtzQhl6/TNUJICDz3rM0Ke3IyBTdpqYqVOBTTz14oAiAqQdKTbRTAU96TOBTgaQjNIB6nFamh3qWmpRmbmJztb2z3rIxgcU8E56UAeu2sAXp0Iq8i4rnvBWqDUdPNrK2Z7YYGTyydj+HT8q6kR0FDAtOC1IEp2ymBGFpdtSbaXbTGS6eMX8f4/yNbdY9iMXsf4/yNbFaQ2Mp7hRRRVkHg3xJH/FwdS/7Zf8AopK5XYSeBn6V6v4utIZvFF40iKSdmSVH9xaw302Db8sa+v3RXM3qzoS0OEMT5+6fypjR4PPFd39ghZidoz3+Wmtp1v3jH5Urj5ThNgyDnH4VbuAGsrZh6Mv612LWVqQB9nQ4GB8oqAWcAuyhiQrt3AFeOtb0neM15fqjCqrSi/P9GcW67f735VEQcHGfyrvjp0ONoii65/1YpDaIRtMUR5yMxr/hWF0a8p5+wZhgZJphhfZwCSfSvRBaxn5Wiix7RipfJUYAihAAwP3S8cAenoKLhY80NtKEJ8tsAZJIqEoSteoraomD5Nu23nmFT/SozZQAMXghY5LEtCvP6UXDlPNVQkcCpljIFei/2fbHDC2g4H/PJf8ACpUtoip/0e3PI/5YL/hRcOU83WJiaXyW+tem7E5xbWvPXFsn+FQC1ijk3R21upBzkQr6Yx0ouHKefCI7sYp6xY616AscaE7ba2/G3Q/0pTDHJB5Jt7cJnJ2wID+eM0XQWOFitpGXKocDnPpUyRN0Urx7125iXyygigwwwf3CZx+VPAOANlv0A/1Cdunai4WOKXcvGM96kAYntXY/MZ/NaOAtu3ZMCHJ/Kphdz7UXy7YLH93/AEaP9eOaAscWM9O3pWhpk0nkuvOc9f6V0yXk6nhbfrn/AI9o+v8A3zUi39wHZsW+WOT/AKNHz+lILM46+27j5hcE9gBWTKIU6ebn6D/GvRheS4IK2+Dwf9Gj/wDiaU3LnrDa4/69Y/8A4mgLHmYuYF6wSN+IFI11Cx+SFh6AsDXoioqTmURQFiSeYEPr2x71K08jLjybVRntax//ABNVcVjzMy91Rh+NN8zB+Zf1FenrPIisqxWvzDB/0WPn/wAdo8+RiCY7clRhf9Gj4H/fNMXKeYM6gfdz/wACpomUdUyMdN2K9RE8yyb1S3U9yLaP/wCJpoTnJigJGcfuE79e1AWPMlvSgzHGAfUGmvf5+/AufUHrXpwjQKR5Nv0x/qE6flSeSpXaYoMenkr/AIUgseWi/ZT/AKkD6NThqJP3oVb3LYr1F41Z1YwwFkXap8pRgflUb28W0/uIMHt5K/4U7i5Ty83j9o1/Og3rkj5FH416jGiqAEjhUDPHlL/hTfsEJyfJhyev7pf8KLhY8uN2zfwKKcL1wuNiH616cdPhBz5EP/fsf4U/7BCwwYYcY/55L/hRcLHlZv33f6tCKtaVdM+oxKyKA2RkfQ16SLC3H/LCLjpmMf4VDd2MC20zLbxKVQkMEANa0JWqxfmjKrG9OXozzNruRXIKLwcUgvJOcRIT+NepW9nbm2jf7PD8yA5MYOaedNtWGTawZ/65iolo2jSKurnlZu5Mf6lAfQZoFzJziNfyNerpYQKpUW8HPP8Aq1/wqT7LEcfuIOBjPkr0/KpuOx5ItzKORGufoaX7TL1Maj8DXrD2UTgBoYSB0/dr/hTP7KtTy1vD/wB8Ci4cp5X57gkFVHrwaXziONgzXqR0mzP/AC6w4/3BQuj2Oci1i/74FFw5TysTsT9zj6GpFmbsn6V6kdKsuM2sP/fsUf2TYgc2sJ/4AKLjseZCVh1X9KPMZj9z9K9M/siw72kP/fApRo2nhf8Aj1i4/wBmlcLHmrxgdqZgY/8ArV6WNDsN2fs6flStoWnlR/o0f4Ci4WPM+nbP4U5MMRkAD1r0f/hHtOYY+zr780p8PacOlulFwsecYX/IoKKBkck+1ejroOnhs/Zk/HmpH0WydQr28e0dABjFK4WPNBt7j9KflcdP0r0FtA08/wDLsv4E0n9g6eF/49l/M0XCx5+CFII7dOKkN/O5GXOD6cYrvV0OxjYFIACDkHJOKY+g2TSFmhyScnnrVxqTirRdiJU4yd2rnE3h3Oj8YdA2aqELmu7g0u1XU2iaJSFVZI8847H9anfQLB2LG3Az6HFa4h3qc3ez+8iivct20+489D4GNopchl54zXdt4csD/wAseMf3jTl8OWG4HyiPbcawubWOCyoPFNMgB6A16EPDun5J+z5yf7xpP+Eb04kkRsP+Bnii4cp58so54HNL5o9BXf8A/COWQziM9eCSeKYnh603NvQqp7K55ouPlOC88DooNPS7yf8AVr+ddwfDWnj+Bv8Avqnnw/p2BiADAxwx5/WlcLHDm79EA/GlF6V6RK34123/AAjmnsF/d9PRjzSjw1p45MRP/Aj/AI0XHY4xLwuceUF/Gr9u6nGSq/jXS/8ACP2IXHkjr13HP86T+wbIdIgPxP8AjSCxmoyJGT5gHHrVW4vt5XjhehrfGjWgH+r7epobR7I8GAcj+83H60Dscy8yOjPFuwp7mhZe45rbu9JtbaESJFhdwDjceRVuLRrKInNtvyO8jf0NdFTWEZeVvu/4FjCmrSlH5/f/AMG5zwk3jBqN1x15rpU0m2TIMAfnqWPH6046XaEn/RlHHTe3+NYXNbHGvHk1AyEHmu0OjWp4+zAc9d7c/rQdGsDhfsYyOpMjc/rRcLHEEGk+tdv/AGFYbifsY+nmt/jSpoGmgfPZ9+vmtRzDscTjDc9KXbXaHQNNDMfs7bT0Hmnj8anXR9JWEK2nFm/vee38qLhY4TbS4Oa7iTR9MIHl6eEOevnMf61G2iae7fLZhcdvNY/1ouHKc1ouqS6RqkN3Dk7D8y/3l7ivZraeK7tY7i3bdFKoZD7GuBGk6YsRVrAFufm85v8AGtLRfFWhaTN/Y11drZyrhkWUnYM9tx4Hrg1S1DY7HGKXFIkiSorxuro3IZTkH6GnigYmKMUtFMCayH+lp+P8q1qyrL/j7T8f5Vq1pHYynuFFFFWQcR4g0DVb3Xrm4tLbfC+3a3mKM4UA8E+orOPhbXP+fLP/AG2T/GvSKKzdNN3NPaNHmw8Ka1j/AI8uf+uqf40h8Ka2f+XH/wAjJ/8AFV6VRR7NB7RnmR8J672sf/I0f/xVUZ/D2rw6taW8tptmuFcRL5ifNtGTznHSvW6wPEP7rXNAuP7t20Wf99cf0rWjTXM13T/IxrTfLfzX5nJL4U10dbE5/wCu0f8A8VSf8InruT/oH/kaP/4qvTaKx9lE29ozzBvCWvE5FgR7CaP/AOKp6+FNe/isP/I0f/xVemUUezQe0Z5sPC2uAf8AHj/5FT/4qhvCmt9rL/yKn+Nek0UezQe0Z5qfC2udrH/yKn/xVKPCutgf8ePX/psn/wAVXpNFHs0HOzzf/hFdaBz9iJ/7ap/8VQfCutf8+X/kVP8AGvSKKPZoPaM80PhTW8/8eP8A5GT/AOKpf+ET1v8A58f/ACMn/wAVXpVFP2aD2jPNP+ET1vHFkf8Av8n+NA8J64Otl/5FT/4qvS6KPZoXOzzf/hFtbx/x4/8AkVP/AIql/wCEW1vH/Hl/5FT/ABr0eij2aDnZ5x/wi2t9fsXP/XVP8aD4X1vtY/8AkVP/AIqvR6KPZoOdnm//AAi+uf8APj/5GT/4qlHhfW9v/Hl/5FT/ABr0eij2aDnZ5wfC2t9rL/yKn/xVA8L65/z5Y/7bJ/jXo9FHs0HOzzr/AIRfW/8Anzz/ANtU/wAacPDGs45s/wDyKn+Neh0UezQc7PPP+EZ1nPNlx/11T/Gnjw1q462f/kVP8a9Aop8iDmZ5+fDOrHn7H/5FT/GkHhnWAT/onHb96n+Neg0UciDnZ56fDOs54s//ACKn+NNPhjWv+fL/AMip/jXolFL2aDmZ54vhjWR1s/8AyKn+NPHhrWB/y5/+RU/xr0CijkQuZnn/APwjesH/AJc//Iqf40f8I1rA6Wn/AJFT/GvQKKPZofMzgP8AhG9Y/wCfP/yKn+NMufDmrfY5t1pgeWc/vE9PrXoVIyh0ZT0YYNVGCTuS5Nqx5xpGi6ld6RbTwWu+NkG0+Yoz27mrh8O6t2tMf9tE/wAa3fBDE+EbRW+9GZEP4O1b9aVqaVSXqyKM26cfRHCjw7qw/wCXT/yIn+NL/wAI7qn/AD6/+RE/xruaKx9mjTmZw3/CPar/AM+n/kRP8aD4e1X/AJ9P/Iif413NFPkQ+ZnDf8I9qv8Az6f+RE/xo/4R3VQOLX/yIn+NdzRRyIOZnDjw/qvObT/yIn+NIfD2q/8APp/5ET/Gu5oo5EHOzh/+Ee1X/n1/8iL/AI0Dw9qn/Pr/AORF/wAa7iil7NBzs4geH9UH/Lr/AORF/wAaX/hH9T/59f8AyIv+NdtRR7NBzs4oeH9Tz/x6/wDkRf8AGj+wNT/59f8AyIv+NdrRR7NBzM4r/hH9T/59f/Ii/wCNIfD+qEf8ev8A5EX/ABrtqKPZoOdnD/8ACO6pn/j1/wDIi/40n/CO6n/z659vMX/Gu5oo9mg52cP/AMI7qeP+PX/yIv8AjSf8I7qmf+PXj/rov+NdzRR7NBzs8zvdGv7TW7Ay2+03G6FfnXk4yB1rTPh3VCuBa/8AkRf8a2PGYMWkW9+o5sbuKfPtnB/nXQgggEcg9K3qQThF/L+vvMYTanJfP+vuODHhvVf+fT/yIn+NSf8ACO6pj/j0/wDIi/413FFYezRtzs4f/hHtU/59f/Ii/wCNIPDuqf8APr/5EX/Gu5oo9mg52cP/AMI9qhH/AB6/+RF/xpP+Ed1X/n1/8iL/AI13NFHs0HOzhD4d1bH/AB6f+RE/xpp8N6t/z6c/9dE/xrvaKPZoOdnCDw3qoHNr/wCRE/xpR4d1Xva/+RF/xruqKPZoOdnC/wDCOaqf+XTH/bRP8aP+Ec1XP/Hp/wCRE/xruqKPZoftGcL/AMI5qmP+PT/yIv8AjTT4c1bP/Hpx/wBdE/xrvKKPZoPaM89u/C2qy2kqC0+8px+8X/Go9I0q/wBR0m3uYLfzEdcbt6jJHB6n1Br0aue8L/6LdavpZ4+y3ZdB6JINy/1raNNOk121/T/IxlNqon30/X/MxT4b1Q/8un/kRf8AGj/hG9U/59P/ACIn+Nd3RWHs0a87OEHhzVR/y6f+RF/xpD4a1U/8uv8A5ET/ABrvKKPZoOdnB/8ACN6qP+XTPr+8T/Gg+HNVxj7J/wCRE/xrvKKPZIftGcGfDmrf8+f/AJET/Gj/AIRzVv8Anz/8iJ/jXeUUezQudnAnw1q3a0/8iJ/jR/wjWrDGLTP/AG0T/Gu+op+zQ/aM8/bwzq5XH2T/AMiJ/jXmmrfDTx3fatc3P9jCRJJCVBuoeF6Aff8ATFfRdFOMFETk2fPmj+Cfiboj50uzntVzkxi9gaM/8BL4/Su70i78fRbU1vwqky9DLbXkKt/3yXwfzFekUVVkLmZiwW93LCrSWkkLHqjshI/75Yj9ak+x3H/PP/x4VrUUuVD52Z9rbTR3Cs6YAzk5HpWhRRTSsS3cKKKKYgooooAKKKKACsfxHY3F7b2Js4/Mkt72KfG4DhSc9fY1sUVUZOMromUVJWYUUUVJQUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFAGJ4VtZ7LTbmC4iaLbdy7AwxlScgj2rbooqpyc5OTJhHliohRRRUlBRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFAGfr1r9t8P31vjJeBtv1AyP1Apvh66+2+HLCcnJaBQx9wMH9RWlR06VfN7nKRy+/zBRRRUFhRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABXPS/6D4/hfomo2jR/V4znP/fNdDVe4sLe7uLeeePdJbOXibcRtJGO3WtISUW79UROLklboWKKKKzLCiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKAI7iR4bWWSGFp5EQssSEBpCBwoJIAJ6ckCuA+H/wAQ9W8XeNfFGi6vosekDRGiRYvN82QsxfJZh8pGFUjA79TXodeRfDT/AJLx8Tv+utp/6C9AHrtFcXB4t1LxR4i1bSvBxsYYNHkEF1qV7G06NcdTEkSOhO0feYuME4ANVtA+IN2PiDceB/GFpb2msCH7RZXNqx8i+i9VViWRhhvlJP3W545AO9orhF8Xa34g8e634a8MpZ6emhxxG5vdRtZJxNJINwVEWRMAD+It+GOad8NfHl54xbXrDWLKC11LQdQexuDbOWilKkjcueRyrcHPbnngA7eRikTMiGRlBIRSAWPpzxXnXg34kav4l+KWu+FtU0SLSU0m3Emwz+dKzFlwSy/KAVYHABx61pWPirV/F+qapF4ONhbadpdwbR9RvoHnFxOoy6Rxq6YVcgby3J6AgZrgvhrLezftLeOm1S3jt7v7HEsiRPvTI8oblOAcEAEZ5AODQB7lRRXJf8JPqGveJtT0Twp9kiXSdqXuo3kTSxrMwyIkjVkLkLyx3jGQOecAHW0Vw3gnxvqeseKNe8L+JdOS21TRWVjc2yOILmJvuuA2ShI5wSe+CcGpLDxJr/jLR59W8EyaXbWCzSRWc2oQyT/btjFC42OnloWUgH5iQM4FAHW3089tYyzWlo15Oq5SBHVC59MsQBXEfC/4g6n47t9fl1TSY9Nl0u+NotpHJvcFV+YM54J3ZGQAP51Z+GPxET4gaTem4s/7P1XTLg219ah96o/OGU9wcH8QevU8x8Cf+Qj8QP8AsZbj+ZoA2PB/xG1fxH8Utc8LapoUekJpNssuxphLKxYqVJZTtAKsDgZ69a9Frx7wl/ydb48/7B1r/wCioK9hoAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiobu7gsLKa7vZkgt4I2kllc4VFAyST6ACuab4gWkNgmo3uj6xaabOYxbXktupScyEBPlVzJHkkDMioORnFACeN/iX4Z+H1sr+Ibx1mkXdFawRl5ZBzjA6DO08sQOOtber63baL4bu9bu0me2tbdrh0hTdIVAzgD1rzj9pRVb4MXhZQSt3AVJHQ78fyJrtte8Y6H4K8Nwah4jvRawGNQuEZ2c4HAVQT3HtzQBoeHddtfE3hyx1qwjnjtr2ISxpcJscA+o/wDrkelGv+INL8MaPLqmu3a2lnEPmkZS3YnAABJOAeAO1N0HxBZeIfDNnr1nvisruATobgBWVPVuSB+dc3qfj6xvfC99fWul6pPor20oGrrAv2fG0jdtLeaUz/GEK45zjmgDb8H+L9M8ceH11nQ/O+xvK8SNMmxm2nBOMng9s8+1bteUfs3EL8FbIsQALm4JJ7fOa6bUfiTp9ho7a1FpOr3+hpkvqlpCjQqoOC+0uJGQcneqFccgkc0AdjRXK6p8S/Cej+E7bxJeavH/AGZdpvt5I0Z2lGQOFAzwSAc4weuKy7X4x+Hb270CG3tNWdNdZY7e4WzJhikbokjg4DYIJC7sA5OBQB31FFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUVyvjb4keGvh/arL4ivGSWQZit4YzJJJ1xgDgZ2nliBx1rOPxZ0qXxDBoum6PreoXd1bme2MFqixXAAy6pJI6oSozk525BAJbAIB3dBIAJJwB1JrkvBXxE0/x3p2p3Wj6dqUL6bO1vNbXaRpI0gGdow5X25I5pvg74jad4z1vWdJtNN1LT73RXWO7ivo41wxLDAKOwP3T7dMZoANA+J/hjxR4xuPDegXcl7d21s1zLMkZEKqrIuAxxk5kHQEcHmuvrx3Q0Vf2v/EhVQC/h5CxA+8d1uMn8AB+Fekal4mt7LUm02ztLrVdSSETvZ2QTdGhOAWZ2VFyQcAsCcHAODQBtUVy3h/4iaF4gXU0Dz6dd6Rn+0LPUI/KltQP4m5KleOqkisOL44+Ebz+1v7JGpao2lqpkSzsmd5s7s7FODhdhyzBVGRzzQB6LRWb4d1208T+HbHWtNWVbW+iEsQmTY4B9R/kelaVABRRRQAUUUUAFFFFAHH6X8UfDGt+OD4V0e7kvb9IXlkeKI+UgXHG44yTuGNuR712FeG6tq1lof7WL3uoSFIl0AABELvIxPCqigszHsACTXc+HPi14f8Q+KH8Ovb6no2rAForTV7Q27zqO6Ak9snBwcA8cGgDuaKydV8R2umX0OnpFPfalPG0sVjaqpkZF4LEsQqrkgZZgMnGc1m+HvH+leINevNBaC80vWrNd82nahGqS7P76lWZWXkcqx6igDqKK5a48e2Z1rUNK0TTNR1670wL9uTThFi3LAkKWlkQFuD8qkn2qXw/4+8PeJPDM2vWF4Y7K2dorn7Qhje3dcZV1PQ8j86AOkrnvF3jTTvBcGny6rBeTLqF4lnELSHzCrt0Lcjjjtk+gNcuvx28IXOmanfaWmqanFpzAOtpZMzyDGS6qSCEXuz7QMgdxV/U/jD4R0qPSBPdzvcawsL2trHAfMxLt2ls4C8MCQTnHTNAHdUVx3jn4p+F/h7Go1+6la6dd0dpbRF5XH6KP+BEZxVLX/jJ4a8OahDFf2+rNYyS+S2rxWLGyjf0804Df8A3dD6UAd9RVHVtb03Q9Fn1fVbyO2sLePzJJ2Pyhe2Mdc5GAOueK5XUPirpei6fBqniDSNa0rSLgqItRubVWjO4ZXKRu0iZ/2kWgDuKKoaRrFrrlkbqxS7SIPs/0uymtmPAOQsqqSORyBjrzwav0AFFFFABRRRQAUUUUAFFFFABRRRQAV5D8M2Vvjv8AE7aQf31qOD6K4NetzRLPBJE5cLIpUlHKMARjhgQQfcHIrlNE+F3hLw5rz6zo1jdW2oSMWln/ALTunMxJyfMDSEPzz8wPPNAHCfAed9F8ReNvCOrMU1W31V7wCQ4aeN+N4HccKc/7Yq/4s0t9Z/aV8HtYLl9KsJbq+kX/AJZxEssYJ92JAHua77WvBmg+INQgv9SsT9vtxiG8t55LedB6CWNlfHJ4zjmrulaHp2ipKNNthE07BppWZnkmIGAXdiWc44ySaAPOtD8Uv4/+IvirSdS1CTTtJ8NzCBbGGQwPdEMwaWWQENsBThVIBDfNnvzPwGazj8d/FFNNlgitn1NEtCjAJtMtzs2+2MYxXqOo/DPwbq3ihfEWo6Ba3GqKQfPfdhiOhZM7WIwOSCeBVrT/AAN4a0rxReeIrDSIIdXvc+ddDJY564BOFz32gZ70AeZ/s467Ba+GNQ8H6o6WuuaVfTGa2kbDupIy3+1htwOOmB6iqngnXNKX9qTxs76laql1bxRQM0ygSuPKUqpzy2eMDmvSvEPwu8F+KtVTUte8P211eKQTNloy+Om/aRv6fxZq7p/gbwxpWuTaxYaHZw6jMFBuPLyyBUCKEz9wBVAwuBxQBv14H8PfGFh4A+K3jfwz4zuY9MbUNUkv7W7uX2RyByW+ZzwMqVIJ4+8M5xXvlc34q+H3hXxt5Z8T6LBfPEMJLlo5FHpvQhse2cUAMg8XaR4ou7vR/DOoW+pMLJ3mu7OdZI7dmwqKWUkbmyxAB4CHPavFfg3qXw2h8Mv4b8f6R4fsfEGlTyxTy6xawAzDzGP+scYJXO3BPRRivftA8N6N4W00af4e06DT7XduMcK43NjG5j1Y4A5OTxWL4k+FvgrxbqQ1DxBoFvdXYIzMrvEz46bijDd+OaAF8Ey+Ep5tSbwLpulw2SNHHNe6ZBHHFcSgMSmUAD7Ay85I+cjqDXG/Adg2oePypBB8STkYPua9Ng0DTLTQf7GsLb7DYCMxrFZO0BQH+6yEMp9wQaxPDXwy8KeD76W78N2FxYzTjE23ULhll68srSFWIycEjIzxQBxPhFlP7VvjzBB/4l1r0PpFBmvYq47TvhT4R0rxF/b1hZXsWqlgz3Z1a7Z5eQcOTKd4JAyrZBxyDXY0AFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFAGX4m0mDX/Cup6ReTm2gvrWS3eYYygdSueeO9eLy+I/Hnwm02LTPiHpkXibwkmy3Gq2hIlhTOF398jjqBzj5ya9s1/SE1/w9f6TLPJbpewNA0sRw6BhglfQ+lc3qvgjVvEGivoGveJBeaLKEWYLYiO7mVWDYaYPswdvO2NT6EUAcx+0TcxXnwLuLm2cSQzT20kbjoylgQfyNdR8R1V/gr4hDqGH9jSnBGeRGSKq/Ev4c3vj/wAOQeH7LXING0uMozxLYGZ3KZ2jd5igKOOMZyOvarWveEPEOv8Aw8fw1P4ks4p7iI291fJpbZkixjCp52FYjqckcnAFAHmviS/u9P8A2NbBrJmQzWNtBIy9o2cBh9CPl/GvXIHsp/hqj6bsaxfSR5G3G3y/J+XHbGMVl+Gvh++nfDp/BnibUYNd03yPs0ZWzNs4j54Y+Y2SOMEbSMDqeaw9B+D2p6BZT6LB471OTw1IrrHpZt0DLuB4MwO7bk5Krsz+JoA4fwXPdW/7G+sSWORL5V0pI6hC+H/8dLV3ngvQv+Es+F2lG08b602m3WmpbyW8UVhtjHl7Hi/49iRt5Xrnjr3rS+H3wr0/wJ4cn0g6lfatBdIyzxXT4gIYAOFiHABx3yeTzzXIRfs7NpWryv4U8d65oOlzvvlsbV2DEegkDj6ZZWP1oA0Nf8KaT4K/Z78VaBoV5d3lraQT5a7ZWZHYBioKqowM54HUnvXS/B6NIvg74ZESKgNijEKMZJySfqSc0niD4ey33w7Pg7w5qkek2MsbRXE09obqWUMdzNnzF+ZiWLMc53Hoeav+AvDOp+D/AA1b6JqGr22p21nEsVq8Vibd1UZzvJkcN1GMBcYOc54AOnooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKAPKP2kv8Aki97/wBfUH/odej+H40h8NaZHCixxpaRKqKMBRsHAFcv8T/AOo/EXQl0WHXoNK09nWSYHTzPJIynIw3mKAvTjGeOvauk8O2Gp6XosVnrOoW2oTQgIk1vaG3BQKANymR8tkEkggcjgY5APLv2ev8Amd/+w/LTfhJ/yW74o/8AX5F/6FLW/a/Ce90fxlqeq+GvGF9pGmavcG5vtNito5N8hJLFJHzsySei5Hr0xL4T+EFh4U8aap4ittZ1J5L+YyfZUmKRBc5Ak5LSsDn5mPOTxQBg6J/yd94h/wCxdT/0O3ql8PpbrWfih8QrCXxPqGj6kmrM629rHanzrdcpG376KRjhVUcEAbhxzXR6X8MvENh8U7nxzL4ts57u8hW2uLUaOyxGEbPlT/SCVP7sEHJ55IPSmeP/AIJ2HjHxCniLSNYu/DuugAPe2gz5mBgEgMp3AcZDDjrmgDT0f4daRoHxKk8VTa7qt/rupW7QuLpoQsqKqAnZFEgGAic8DOM8muQ+Ekaf8Ly+J8mxd63cYDY5ALyEjPvgflXaeDfh5L4Rtbu5l8QXuu69cQGJdT1ZnnEQ6hVQvkJuwSobJx1GBjM8HfDPXfCfjTWPEDeKbO+bW5hLfQNpDR5wzHEbCf5fvEZIb3zQB6TRRRQAUUUUAFFFFABRRRQB4yVB/bCBIBK6BkZHQ5qX46aekmveAL6xj/4m669DDA6D5ihIZhn0BVT7ZPvXV678OjfeO4PGWhazLpetxW/2ZjJAtxbyx88NGSp79Qw6CtK08Jeb4ittf8SXiapqlnE0Vp5cHkwWu777RxlmIZhgFizHAwMc5APONLup7/8AaT8ZaXP4kvtFuntrQWSWyW586NIgzKPOifoXLYXGcse3HWf8K40u0+I2leLtW8Saxe61GDaWouGt0SUeXIShWKFM4Uu34e1R/Ej4P6X8QL221WO/udG1u0UJDf2wycAkjcuRnBJIIIPvU/gX4ZSeFLz+0dc8Tap4n1NYzFDcahMxS3Q/eEaMzbScDJyePTnIBQ8LXdrq3ijxPH8PLG20u2GoFdW1iUNI1zdj74ii3YGMnLnAyc7WyTWJ+zsZEtfGUEkrS+Xr8vzsACxwAScADJwOnFbmk/CO50Dxfqmo6F4u1DT9H1ac3F3pUMKZZySTtmOSg5I+UBsfxcA1N4O+Flx4HvNbm0TxHKYtQuHuLa0ntt0MDtwC+HDy4Bxjco7kZANAHM/ASKMeLfiRIEUP/bjLuxzjzJeM+lXP2glU2Pg1io3DxJbgHHIBDZ/kPyrY+H3w01nwLrmq3reJ7XUoNYuTdXsLaUYmL/Mco4mIXlu6twO3WpPiV8N9W+INxpwg8TQ6TaabOt1DEum+c5mHRmYygEDsNo6nOaAOT/arA/4Vbppxz/bMXP8A2xmrd/aIRU+BurKihVWS2CgDAH75OlT/ABG+GGufEnQbHSdT8UWVpBbSLcSG30hsyzAOu7mc7V2v93nnJz0Au+OfAeu+O/A8fh2+8SWNt5hDXtxDpTEzFXDJtUz/ACdBnlsnptHFAGL8QfDlx4s/Z0trWC8it5orC1uy9xKER9iKSGY8DIzyeMgVX8bXmo/EX4Sf8Izpfh3VrfWtRW1WSO8spIYbTbIjszTMoRlAUj5SWOenarfi7QpoPhppngnXPEaSane3NvZ6VdWtqbcs0e0qZFLuDt2FmIKg/KAAcZt/8IR8TwuB8XM4HGfDdt/8VQB3Wg6Z/YvhzTdLMzTmxtIrfzW6vsQLuPucZq/XNeBtR1a/0e6i16e3vLqwvJLT7daoEjuwgX5woJ2kElGHZkauloAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKAMHxb4K0HxxpiWPiOyFzHE++F1cpJE3qrDkfyNc5YfB+ws5cXHizxhf2v/Plc63J5JHphApx+Neg0UAQ2dnbafZw2ljBHb20KBIoolCqijoAB0FTUUUAFFFFABRRRQAUUUUAFFFFAH//Z)

**Fig. 18.** A photograph of the demonstrator mounted in the static force and torque measurement rig.



Translator

I-core

Rotor

**Fig. 19.** A solid model of the demonstrator without the frame, non-magnetic I-core spacers, bolts and load cells.

Static force and torque were measured using load cells as shown in Fig. 18. Rotor angle was set manually to predetermined positions defined by an array of holes on the angle disk. The translator’s position, which can be adjusted using a screw-nut arrangement, was measured using a ruler. In addition to the static torque measurement, slow speed operation was also verified.

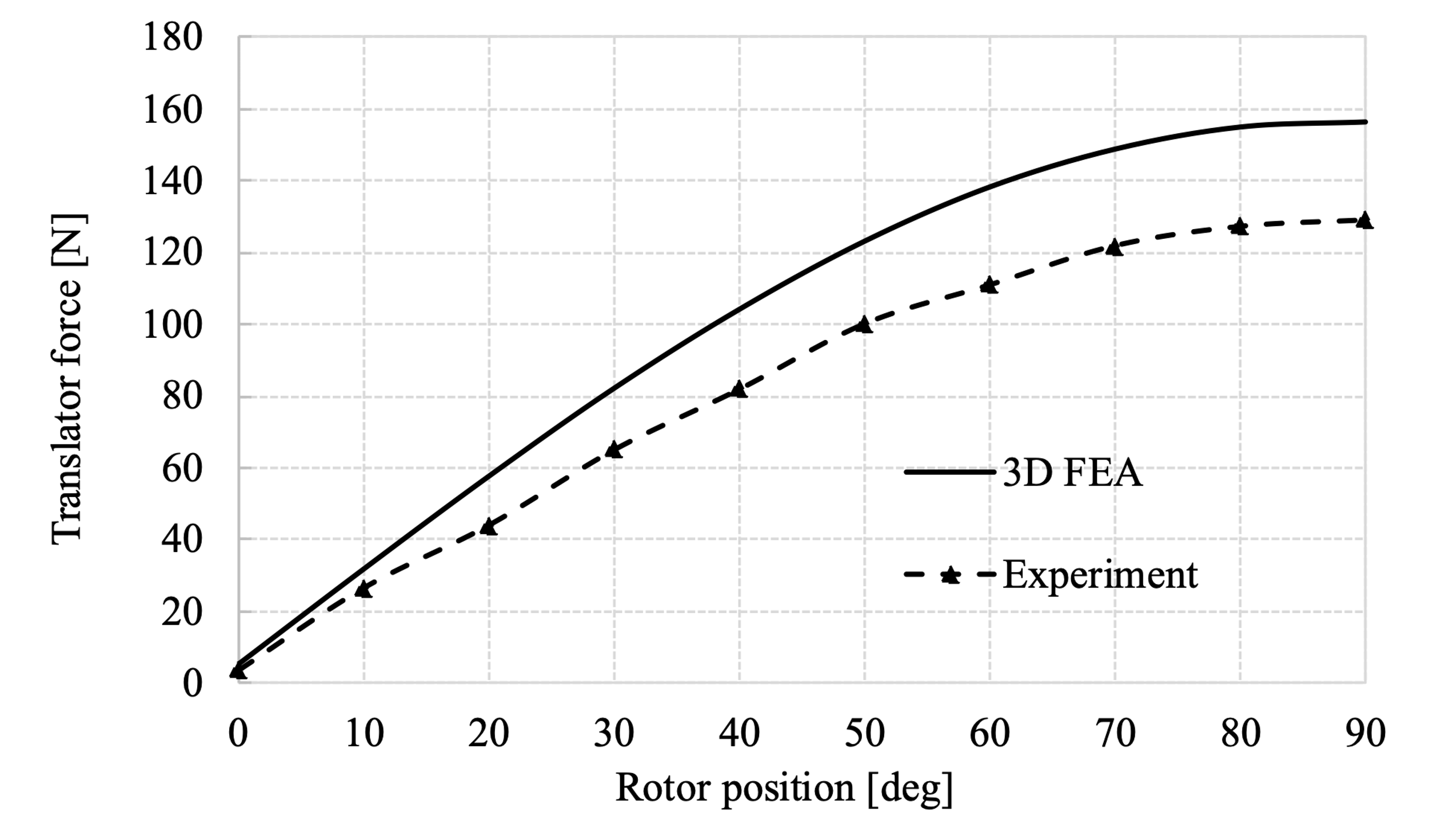
Fig. 20 shows the static torque versus rotor position. Fig. 21 shows the corresponding translator force versus rotor position. Note that the FEA curves in Fig. 20 and 21 are a bit higher than the FEA curves in our ICEM2020 paper [51], which due to human error used the FEA values obtained for a magnetic gear using 5 mm thick magnets on both the rotor and the translator instead of 10 mm thick magnets on the rotor. The FEA values are generally higher than the experimental values, which is probably due to the uncertainty of material characteristics.

Mechanical tolerances, e.g., airgap tolerance and the relative positioning of the magnets and the I-cores are possible reasons for the observed differences between the FEA and experimental values. The latter, the relative position of the magnets and I-cores, in particular is known to have a detrimental effect on performance, especially in magnetic gears where the iron-cores are used to modulate the flux to produce flux harmonics to match different number of poles on either side [49] [54]. The tolerances in the demonstrator are mm. Three-dimensional FEA was carried out to investigate the effect of shifting the I-cores axially from their nominal position as shown in Fig. 22. When shifted by 0.1 mm, the torque and force change by 0.4% and 2%, respectively. The effect of tolerances does not seem to be detrimental in the proposed device because it has one I-core per pole in the axial direction, i.e., the force is produced by the fundamental flux, not one of the harmonics.

Chart, line chart

Description automatically generated

**Fig. 20.** Torque versus rotor angle.



**Fig. 21.** Force versus rotor angle.

Chart, line chart

Description automatically generated

**Fig. 22.** Effect of I-core position tolerance on torque and force.

The torque peaks at 70 degrees, not 90 degrees as expected, which is due to a combination of saturation of the I-cores and cogging torque. The force peaks at nearly 90 degrees. The characteristics in Figs. 20 and 21 suggest that the ratio of torque/force is largely independent of the load up to about 60 degrees. However, at higher angles, we observe significant load dependency. In practice, this will be acceptable as gears are not usually operated close to their pull-out loads.

V. Discussion

In the demonstrator, the translator’s gap shear stress is 40 kN/m2, which is significantly below those reported for magnetic lead screws and similar devices which are reported to achieve shear stresses of 80-230 kN/m2 [45], [49]; it is an order of magnitude lower than mechanical devices which were reported to have shear stress values ranging from 4 MN/m2 for pneumatic devices to 83 MN/m2 for hydraulic ones [49]. Using stronger magnets and reducing the gaps to say 0.5 mm would increase the shear stress of the demonstrator by about 25%, to 50 kN/m2 according to Fig. 13. Further improvement can also be achieved by increasing the number of translator polygon sides as illustrated in shown in Fig. 7, which increases the number of segments of the magnet helix and in turn the shear stress as was shown by Pakedlian et al. in [45]. Further improvement could be achieved by selecting I-core dimensions close to their optimal values as suggested by Figs. 14 to 16. Removing the I-cores all together will indeed result in greater force as it allows a further reduction of the total airgap, by having one instead of 2 airgaps and eliminating flux reduction due to I-core reluctance which can become significant due to partial saturation. This will also eliminate I-core losses. Arc magnets will need to be used instead.

The development of this proposed rotary-to-linear magnetic gear was initially motivated by finding a more efficient and quieter alternative to the ball screw used to couple an oscillating mass to a rotary electric machine in the wave energy harvesting device described in [9]. Its shear stress is however similar to that of direct-drive linear machines, which may be a simpler alternative that merits evaluation for this application. But there are many other applications which simply require conversion of rotary-to-linear motion or vice versa, for which the proposed device may be suitable.

As seen in Fig. 17, the demonstrator exhibits significant torque and force ripple. This is partly due to the pole-slot combination (one I-core, hence one slot per pole in the axial direction, and 2 peripheral slots per pole). It also arises as a result of the discretization and non-uniform magnetization of the PM helix as discussed by Wang and Gao et al. [55]. The former could be reduced by carefully sizing the slot opening and magnet width to minimise permeance variations seen by the magnets as they move, as proposed by Ackermann et al. [56], for example. Increasing the number of translator polygon sides to achieve a close approximation to an ideal PM helix as illustrated in Fig. 7 will also help reduce torque and force ripple. Skewing of the magnets or the I-cores is another possible method for reducing torque and force ripple.

The starting point for the development of the magnetic gear demonstrator was the VRPM transverse flux machine. Insights into the similarities of its principle of operation to that of magnetic screws with and without iron modulators were gleaned later. One of the insights is that we can reduce the amount of magnet material on the rotor by using the central I-cores as the translator. This will also have the added benefit of confining the flux to the active section [47].

In common with magnetic couplings and gears, the proposed device has significantly lower stiffness and damping than mechanical counterparts. This can result in significant oscillations and high transient forces that can cause the device to lose synchronism. These oscillations can be reduced by careful analysis of the dynamics of the whole system including the electrical machine and load taking into account nonlinearities and the design of appropriate control systems [57], [58], [59].

# VI. Conclusions

The proposed magnetic gear, which was derived from the VRPM transverse flux machine is, upon close examination, fundamentally similar to that of a magnetic screw with helical magnets. In effect it was shown to be equivalent to magnetic screw gear with a discretised magnet helix.

The same topology allows an additional design variable, namely having different number of poles (along the axial direction) on both the rotor and the stator, and the selection of an appropriate number of I-cores to modulate the flux. This results in a gear that is essentially like that proposed in [48], [49] [50], but with the ferromagnetic rings replaced with I-cores, which will enable a finer adjustment of the gear ratio.

The demonstrator, which was optimised using 3D FEA considering manufacturing and available magnet dimensional constraints, the translator’s gap shear stress is 40 kN/m2, which is significantly lower than that of magnetic screws, but there is scope for improvement by further topology and dimension optimisation.

The I-cores reduce the force density due to the double gap, and they will incur core losses and increase torque and force ripple, but they can be used advantageously as flux modulators to provide fine adjustment of the gear ratio. Furthermore, they can be advantageously made the translating member, which will economise on magnet material that will be confined to the active section, thus reducing stray flux.

# References

|  |  |
| --- | --- |
| [1] | X. Li, K.-T. Chau, M. Cheng and W. Hua, "Comparison of Magnetic-Geared Permanent-Magnet Machines," *Progress In Electromagnetics Research,* vol. 133, pp. 177-198, 2013, doi: 10.2528/PIER12080808. |
| [2] | B. McGilton, R. Crozier, A. McDonald and M. Mueller, "Review of magnetic gear technologies and their applications in marine energy," *IET Renewable Power Generation,* vol. 12, no. 2, pp. 174-181, 2018, doi: 10.1049/iet-rpg.2017.0210. |
| [3] | P. M. Tlali, R. Wang and S. Gerber, "Magnetic gear technologies: A review," in *International Conference on Electrical Machines (ICEM)*, Berlin, 2014, pp. 544-550. |
| [4] | Y. Wang, M. Filippini, N. Bianchi and P. Alotto, "A Review on Magnetic Gears: Topologies, Computational Models, and Design Aspects," *IEEE Transactions on Industry Applications,* vol. 55, no. 5, pp. 4557-4566, 2019, doi: 10.1109/TIA.2019.2916765. |
| [5] | N. W. Frank and H. A. Toliyat, "Gearing ratios of a magnetic gear for wind turbines," in *IEEE International Electric Machines and Drives Conference*, Miami, 2009, pp. 1224-1230. |
| [6] | L. MacNeil, B. Claus and R. Bachmayer, "Design and evaluation of a magnetically-geared underwater propulsion system for autonomous underwater and surface craft," in *Oceans*, St. John's, 2014, pp. 1-8. |
| [7] | A. Rotondale, M. Villani and L. Castellini, "Analysis of high-performance magnetic gears for electric vehicle," in *IEEE International Electric Vehicle Conference (IEVC)*, Florence, 2014, pp. 1-6. |
| [8] | K. K. Uppalapati, J. Z. Bird, D. Jia, J. Garner and A. Zhou, "Performance of a magnetic gear using ferrite magnets for low speed ocean power generation," in *IEEE Energy Conversion Congress and Exposition (ECCE)*, Raleigh, NC, 2012, pp. 3348-3355. |
| [9] | M. Hendijanizadeh, M. Moshrefi-Torbati and S. M. Sharkh, "Design guidelines for Optimization of an Inertially Coupled Energy Harvesting Generator from Boat Motion," *Journal of Renewable and Sustainable Energy,* vol. 7, no. 4, p. 43123, 2015, doi: 10.1063/1.4928174. |
| [10] | G. Marsh, "Tidal turbines harness the power of the sea," *Reinforced Plastics,* vol. 48, no. Issue 6, pp. 44-47, 2004, doi: 10.1016/S0034-3617(04)00344-3. |
| [11] | C. G. Armstrong, "Power transmitting device". United States of America Patent 687,292, 26 November 1901. |
| [12] | H. T. Faus, "Magnet gearing". United States of America Patent 2,243, 555, 27 May 1941. |
| [13] | D. R. Huang, Y. D. Yao, S. M. Lin and S. J. Wang, "The radial magnetic coupling studies between magnetic gears," *IEEE Transactions on Magnetics,* vol. 31, no. 6, pp. 3752-3754, 1995, doi: 10.1109/20.489760. |
| [14] | K. Ikuta, S. Makita and S. Arimoto, "Non-contact magnetic gear for micro transmission mechanism," in *Proceedings. IEEE Micro Electro Mechanical Systems*, Nara, Japan, 1991, pp. 125-130, doi: 10.1109/MEMSYS.1991.114782. |
| [15] | M. Hetzel, "Low friction miniature gear drive for transmitting small forces, and method of making same". United States of America Patent 3,792,578, 19 February 1974. |
| [16] | S. Rand, "Magnetic transmission system". United States of America Patent 3,523,204, 4 August 1970. |
| [17] | Y. D. Yao, D. R. Huang, C. C. Hsieh, D. Y. Chiang and S. J. Wang, "Simulation study of the magnetic coupling between radial magnetic gears," *IEEE Transactions on Magnetics,* vol. 33, no. 2, pp. 2203-2206, 1997, doi: 10.1109/20.582770. |
| [18] | E. P. Furlani, "A two-dimensional analysis for the coupling of magnetic gears.," *IEEE Transactions on Magnetics,* vol. 33, no. 3, pp. 2317-2321, 1997, doi: 10.1109/20.573848. |
| [19] | H. A. Hussain, "A Novel Contactless Rotary-to-Linear Magnetic Actuato," in *2019 IEEE International Electric Machines & Drives Conference (IEMDC)*, 2019, pp. 1081-1086. |
| [20] | S. Kikuchi and K. Tsurumoto, "Design and characteristics of a new magnetic worm gear using permanent magnet," *IEEE Transactions on Magnetics,* vol. 29, no. 6, pp. 2923-2925, 1993, doi: 10.1109/20.280916. |
| [21] | S. Kikuchi and K. Tsurumoto, "Trial construction of a new magnetic skew gear using permanent magnet," *IEEE Transactions on Magnetics,* vol. 30, no. 6, pp. 4767-4769, 1994, doi: 10.1109/20.334216. |
| [22] | C. Huang, M. Tsai and B. Lin, "Development of New Magnetic Planetary Gears for Transmission Systems," in *IEEE International Magnetics Conference (INTERMAG)*, San Diego, CA, 2006, pp. 225-225. |
| [23] | M. Tsai and C. Huang, "Development of a Variable-Inertia Device With a Magnetic Planetary Gearbox," *IEEE/ASME Transactions on Mechatronics,* vol. 16, no. 6, pp. 1120-1128, 2011, doi: 10.1109/TMECH.2010.2077679. |
| [24] | C. Huang, M. Tsai, D. G. Dorrel and B. Lin, "Development of a Magnetic Planetary Gearbox," *IEEE Transactions on Magnetics,* vol. 44, no. 3, pp. 403-412, 2008, doi: 10.1109/TMAG.2007.914665. |
| [25] | K. Atallah and D. Howe, "A novel high-performance magnetic gear," *IEEE Transactions on Magnetics,* vol. 37, no. 4, pp. 2844-2846, 2001, doi: 10.1109/20.951324. |
| [26] | A. H. Neuland, "Apparatus for transmitting power". United States of America Patent 1,171,351, 1916. |
| [27] | T. B. Martin, "Magnetic Transmission". United States of America Patent 3,378,710, 1968. |
| [28] | K. Atallah, J. Wang and D. Howe, "A high performance linear magnetic gear," *Journal of Applied Physics,* vol. 96, no. 10, p. 10N516, 2005, doi: 10.1063/1.1853900. |
| [29] | W. Bomela, J. Z. Bird and V. M. Acharya, "The Performance of a Transverse Flux Magnetic Gear," *IEEE Transactions on Magnetics,* vol. 50, no. 1, pp. 1-4, 2014, doi: 10.1109/TMAG.2013.2277431. |
| [30] | R. Safarpour and S. Pakdelian, "Topology Optimization of the Reluctance Magnetic Gear,," *IEEE Transactions on Magnetics,* vol. 58, no. 8, pp. 1-7, 2022, doi: 10.1109/TMAG.2022.3144172. |
| [31] | K. Aiso, K. Akatsu and Y. Aoyama, "A Novel Reluctance Magnetic Gear for High-Speed Motor," *IEEE Transactions on Industry Applications,* vol. 55, no. 3, pp. 2690-2699, 2019, doi: 10.1109/TIA.2019.2900205. |
| [32] | S. A. Afsari Kashani, "Design and Optimization of Coaxial Reluctance Magnetic Gear with Different Rotor Topologies," *IEEE Transactions on Industrial Electronics,* vol. 69, no. 1, pp. 101-109, 2022, doi: 10.1109/TIE.2021.3053886. |
| [33] | S. Hasanpour, M. C. Gardner, M. Johnson and H. A. Toliyat, "Comparison of Reluctance and Surface Permanent Magnet Coaxial Magnetic Gears," in *2020 IEEE Energy Conversion Congress and Exposition (ECCE)*, 2020. |
| [34] | W. H. Keller and S. D. Sibley, "Reciprocating motor,” U.S. Patent 1 043 573, Nov. 5, 1912.". United States of America Patent 1 043 573, 1912. |
| [35] | B. Andrews, "Magnet screw". United States of America Patent 1,562,730, 24 November 1925. |
| [36] | R. J. A. Paul, "Magnetic Rotary-Linear or Linear-Rotary Converter," *IEE Journal on Electric Power Applications,* vol. 2, no. 4, pp. 135-138, 1979, doi: 10.1049/ij-epa.1978.0019. |
| [37] | R. J. A. Paul, "Magnetic rotary-to-linear convertor," *IEE Journal on Electric Power Applications,* vol. 1, no. 4, pp. 115-116, 1978, doi: 10.1049/ij-epa.1978.0019. |
| [38] | J. Gerrard and R. J. A. Paul, "Rectilinear screw-thread reluctance motor," *Proceedings of the Institution of Electrical Engineers,* vol. 118, no. 11, pp. 1575-1584, 1971, doi: 10.1049/piee.1971.0288. |
| [39] | S. Pakdelian, "A compact and light-weight generator for backpack energy harvesting," in *2016 IEEE Energy Conversion Congress and Exposition (ECCE)*, 2016, pp. 1-8. |
| [40] | D. Mustafa and H. A. Hussain, "A Survey on the Design and Analysis of Magnetic Screws," in *2021 IEEE Energy Conversion Congress and Exposition (ECCE)*, 2021, pp. 3759-3766. |
| [41] | K. Rhinefrank, A. F. Yokochi, A. von Jouanne, M. Dittrich and E. Agamloh, "Magnetic helical screw drive". United States of America Patent 20 090 251 258 A1, 8 October 2009. |
| [42] | N. G. Vitale, "Rotary torque-to-axial force energy conversion apparatus". United States of America Patent 6 190 409 B1, 20 February 2001. |
| [43] | J. Wang, K. Atallah and W. Wang, "Analysis of a Magnetic Screw for High Force Density Linear Electromagnetic Actuators," *IEEE Transactions on Magnetics,* vol. 47, no. 10, pp. 4477-4480, 2011, doi: 10.1109/TMAG.2011.2157464. |
| [44] | S. Pakdelian, N. W. Frank and H. A. Toliyat, "Principles of the Trans-Rotary Magnetic Gear," *IEEE Transactions on Magnetics,* vol. 49, no. 2, pp. 883-889, 2013, doi: 10.1109/TMAG.2012.2215046. |
| [45] | S. Pakdelian, N. W. Frank and H. A. Toliyat, "Magnetic Design Aspects of the Trans-Rotary Magnetic Gear," *IEEE Transactions on Energy Conversion,* vol. 30, no. 1, pp. 41-50, 2015, doi: 10.1109/TEC.2014.2361289. |
| [46] | K. Jenney and S. Pakdelian, "Magnetic Design Aspects of the Trans-Rotary Magnetic Gear Using Quasi-Halbach Arrays," *IEEE Transactions on Industrial Electronics,* vol. 67, no. 11, pp. 9582-9592, 2020, doi: 10.1109/TIE.2019.2955424. |
| [47] | K. N. Jenney and S. Pakdelian, "Leakage Flux of the Trans-Rotary Magnetic Gear," *IEEE Transactions on Magnetics,* vol. 55, no. 7, pp. 1-8, 2019, doi: 10.1109/TMAG.2019.2894934. |
| [48] | M. B. Kouhshahi and J. Z. Bird, "Analysis of a magnetically geared lead screw," in *IEEE Energy Conversion Congress and Exposition (ECCE)*, Milwaukee, 2016, 1-5. |
| [49] | M. B. Kouhshahi, J. Z. Bird, J. D. Kadel and W. B. Williams, "Designing and Experimentally Testing a Magnetically Geared Lead Screw," *IEEE Transactions on Industry Applications,* vol. 54, no. 6, pp. 5736-5747, 2018, doi: 10.1109/TIA.2018.2846651. |
| [50] | M. B. Kouhshahi, J. Z. Bird, A. Jannsen, J. Kadel and W. Williams, "A Magnetically Geared Lead Screw Without Translator Skewing," in *2018 IEEE Energy Conversion Congress and Exposition (ECCE)*, 2018, pp. 4994-4999. |
| [51] | Lang, V. T., S. M. Sharkh, J. R. Anglada, M. Hendijanizadeh and M. Moshrefi-Torbati, "Low Cost Rotary-to-Linear Magnetic Gear," in *2020 International Conference on Electrical Machines (ICEM)*, 2020, pp. 1923-1929. |
| [52] | M. R. Harris and B. C. Mecrow, "Variable reluctance permanent magnet motors for high specific output," in *Sixth International Conference on Electrical Machines and Drives (Conf. Publ. No. 376)*, Oxford, UK, 1993, pp. 437-442. |
| [53] | M. R. Harris, G. H. Pajooman and S. M. Sharkh, "Performance and design optimisation of electric motors with heteropolar surface magnets and homopolar windings," *IEE Proceedings - Electric Power Applications,* vol. 143, no. 6, pp. 429-436, 1996, doi: 10.1049/ip-epa:19960766. |
| [54] | R. C. A. K. W. J. Holehouse, "Design and Realization of a Linear Magnetic Gear," *IEEE Transactions on Magnetics,* vol. 47, no. 10, pp. 4171-4174, 2011, doi: 10.1109/TMAG.2011.2157101. |
| [55] | Q. Wang, F. Gao, J. Zhang and Y. Li, "Analysis and Reduction of Detent Effect in Magnetic Lead Screws With Parallel Magnetized Permanent Magnet Segments," *IEEE Access,* vol. 8, pp. 84177-84187, 2020, doi: 10.1109/ACCESS.2020.2991786. |
| [56] | B. Ackermann, R. Sottek, J. H. H. Janssen and R. van Steen, "New technique for reducing cogging torque in a class of brushless DC motors," *IEE Proceedings B (Electric Power Applications),* vol. 139, no. 4, pp. 315-230, 1992, doi: 10.1049/ip-b.1992.0038. |
| [57] | S. Pakdelian, M. Moosavi, H. A. Hussain and H. A. Toliyat, "Control of an Electric Machine Integrated With the Trans-Rotary Magnetic Gear in a Motor Drive Train," *IEEE Transactions on Industry Applications,* vol. 53, no. 1, pp. 106-114, 2017, doi: 10.1109/TIA.2016.2606092. |
| [58] | M. Desvaux, R. Le Goff Latimier, B. Multon, S. Sire and H. Ben Ahmed, "Analysis of the dynamic behaviour of magnetic gear with nonlinear modelling for large wind turbines," in *2016 XXII International Conference on Electrical Machines (ICEM)*, Lausanne, 2016, pp. 1332-1338. |
| [59] | R. G. Montague, C. M. Bingham and K. Atallah, "Dual-observer-based position-servo control of a magnetic gear," *IET Electric Power Applications,* vol. 5, no. 9, pp. 708-714, 2011, doi: 10.1049/iet-epa.2011.0046. |

1. This work was supported in part by TSL Technology Ltd, Professor Mike Russell and the Vietnamese government. (*Corresponding author: Suleiman M. Sharkh*).

   Thang V. Lang is with the Faculty of Mechanical Engineering, Industrial University of Ho Chi Minh City, Vietnam (email: langvanthang@iuh.edu.vn).

   Suleiman M. Sharkh is with the Department of Mechanical Engineering, University of Southampton, UK (e-mail: suleiman@soton.ac.uk).

   Jaime R. Anglada is with the Department of Mechanical Engineering, University of Southampton (e-mail: J.Renedo-Anglada@soton.ac.uk)

   M. Hendijanizadeh is with the Department of Mechanical Engineering, University of Southampton (e-mail: m.hendijanizadeh@soton.ac.uk).

   M. Moshrefi-Torbati is with the Department of Mechanical Engineering, University of Southampton (e-mail: M.M.Torbati@soton.ac.uk).

   Color versions of one or more of the figures in this article are available online at http://ieeexplore.ieee.org. [↑](#footnote-ref-2)